

TRANSACTIONS
OF THE
ROYAL SOCIETY OF SOUTH AFRICA.
VOL. IX.

CONTRIBUTIONS TO OUR KNOWLEDGE OF THE
FRESHWATER ALGAE OF AFRICA.*

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3. *Freshwater Algae (exclusive of Diatoms), mainly from the Transkei Territories, Cape Colony.*

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AND

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(With 29 figures in the text.)

A. INTRODUCTORY REMARKS.

The samples of freshwater Algae dealt with in the present communication were mainly collected in the district of Kentani from an altitude ranging from about 1200 feet to sea-level, although a certain number were gathered at Malan in the Willowvale District, from Quingolo in the Mqanduli District, and from N'quamakwe; apart from these, four samples were obtained from

*The first paper of this series was published in the 'Annales de Biologie Lacustre,' vii, 1914, pp. 40-59 (Plate I); the second in the 'Annals of the South African Museum,' ix, 1918, pp. 483-611. The earlier literature dealing with the freshwater algal flora of South Africa is considered in the latter paper.

†The second author is occupied in collecting and making arrangements for the collection of freshwater Algae in various parts of South Africa, and in supplying such details as to local conditions, etc., as may be required. The systematic working out of the collections is undertaken by the first author, who is solely responsible for this part of the present report. A large number of the figures have been drawn by Dr. E. J. Salisbury, to whom the authors are greatly indebted.

pools of the Buffalo River at King William's Town. The total number of species recorded (exclusive of Diatoms) is 146 belonging to 63 genera (or, if we exclude the samples from King William's Town, 141 species and 61 genera); these include six new species, a new subspecies, and thirteen new varieties, apart from a number of new forms.

According to Miss Pegler, who has been mainly instrumental in collecting these samples, the collections may be considered as fairly representative of the Kentani District, though no samples were taken from the largest rivers. If this is a fair statement the algal flora is very poor in many respects, especially in the paucity of Protococcales and in the scanty representation of most genera of Desmids. The latter were plentiful as a matter of fact only in samples 36 and 327, and only the genera *Closterium* and *Cosmarium* were at all commonly present. The great scarcity of species of *Euastrum* and *Staurostrum* is especially striking, and, although the same feature was noted in the collections from the Cape (see the second report of this series), it does not apply to South Africa generally, as is demonstrated in other collections in course of being worked out. The Zygnemaceae are relatively well represented, which is perhaps due to many of the samples having been taken from small, stagnant pools, whilst the rather marked preponderance of Blue-green Algae in many of the collections is a feature often associated with conditions unfavourable to the growth of green forms.

In her introduction to the Flora of Kentani Miss Pegler* remarks that Kentani is said to be drying up and that surface water is less, streams smaller, and marshes disappearing. Herein perhaps lies the explanation for the scanty algal flora.

Amongst points of special interest may be noted the extension of the range of *Pediastrum integrum* var. *pearsoni* (*P. pearsoni* G. S. West), the discovery of *Zygnema cyanospermum* Cleve in South Africa, and the finding of *Mougeotia uberosperma* W. and G. S. West, hitherto only recorded from Huilla in Angola.

The Diatom-flora, which is rather abundant, presented so many points of difficulty that, in order not to delay further the publication of these results, it has been thought advisable to omit it. A number of the Diatoms are, however, mentioned in the following enumeration of samples.

B. ENUMERATION OF THE SAMPLES.

The following list serves as a key to the collections, the numbers of the samples only being cited in the subsequent systematic portion. With the exception of samples 78-87, which were collected by Mr. M. Lundie from Malan in the Willowvale District, all the samples were gathered by Miss A. Pegler, A.L.S., mainly from the district of Kentani. The numbers

* 'Annals of the Bolus Herbarium,' ii, 1916, p. 3.

cited refer to the general collection of South African Algae (cf. footnote † on p. 1).

17-25. In pools, partly sheltered by sedges, formed by a slow-running spring, Kentani, August 28, 1912. (*Gloeocystis infusionum*, *Ulothrix tenerrima*, *U. moniliformis*, *Oedogonium* sp., *Vaucheria* sp., *Closterium ehrenbergii*, *C. lanceolatum*, *C. acerosum*, *Zygnema pectinatum*, *Ophiocytium* spp., *Tribonema bombycinum* f. *minor*, *Oscillatoria tenuis*, *Lyngbya* spp., *Euglena spirogyra*, *Trachelomonas* spp., *Nitzschia sigmoidea*, *Gomphonema gracile*, *Stauroneis phoenicenteron*, *S. anceps*, *Synedra ulna*, *Cymbella naviculiformis*, *Pinnularia hemiptera*, *P. madagascariensis*, *Navicula producta*, *N. vulgaris*.)

26. On rock in running stream, Kentani, September 20, 1912. (The main mass a foliose Liverwort, with *Closterium moniliferum*, *Pleurotaenium ehrenbergii*, *Cosmarium granatum*, *C. subcrenatum*, and a number of Diatoms — *Synedra* spp., *Nitzschia sigmoidea*, *N. tryblionella* var. *levidensis*, *Amphipleura pellucida*, *Gomphonema intricatum*, *Cymbella helvetica*, *Navicula radiosa*.)

28. On leaves, in closed pool, Kentani, September 20, 1912. (*Ulothrix tenerrima*, *Oscillatoria tenuis*, *Synedra ulna*, *Nitzschia sigmoidea*, *Gomphonema* spp., *Achnanthes minutissima*, *Navicula bicapitata*, *N. radiosa*.)

29, 30. In a stream, stagnant through drought, Kentani, September 24, 1912. Reddish-yellow deposit due to iron-bacteria. (*Ulothrix tenerrima*, *Oedogonium* sp., *Ophiocytium gracilipes*, *Tribonema bombycinum* f. *minor*, *Anabaena inaequalis* (?), *Euglena spirogyra*, *Trachelomonas* spp., and various Diatoms.)

31. Pool in connection with slow spring, Kentani, October 12, 1912. (*Chlamydomonas* sp. (Palmella-stage), *Nitzschia sigmoidea*.)

32. On muddy bank, Kentani, October 12, 1912. (Iron-bacteria and *Navicula mesolepta*, *Nitzschia sigmoidea*.)

33. Attached to submerged rock in running water, Kentani, November 11, 1912. (*Spirogyra* sp., *Synedra ulna*.)

35. Kentani, November, 1912. (Leafy Liverwort with *Closterium moniliferum*, *Synedra* spp.)

36. Kentani, November, 1912. (*Oocystis solitaria*, *Oedogonium pusillum* forma, *Cylindrocystis brebissonii* and var. *minor*, *Penium minutum* var. *productum* n. var., *Closterium parvulum*, *Euastrum submontanum* n. sp., *Cosmarium quadratum* var. *africanum* n. var., *Zygnema pectinatum*, *Mougeotia uberosperma*, *Glaucocystis nostochinearum*, *Stigonema turfaceum*, *Eunotia* spp.)

64, 65. In half-stagnant, exposed pools, Kentani, August 6, 1912. (*Closterium moniliferum*, *Cosmarium meneghinii* f. *africana*, *Spirogyra majuscula*, *Zygnema* sp., *Mougeotia* sp., *Synedra* spp.)

66. Open stagnant pools, Kentani, July 24, 1912. (*Vaucheria* sp., *Spirogyra* sp., *Mougeotia* sp., *Synedra pulchella*.)

67. Slime on mud in exposed drying bed of stream, Kentani, July 24, 1912. (*Euglena* sp.)

68. Pools of Buffalo River at King William's Town, December, 1912. (*Phormidium inundatum*, *Nitzschia palea*.)

69. Pools of Buffalo River at King William's Town, December, 1912. (*Phormidium autumnale*, *Trachelomonas volvocina*, *Nitzschia stagnorum*, *Achnanthes coarctata*.)

70, 71. Pools of Buffalo River at King William's Town, December, 1912. (*Pediastrum tetras* var. *apiculatum* n. var., *Tetradron minimum*, *Scenedesmus quadricauda* and var. *abundans*, *Stigeoclonium falklandicum* (?), *Cosmarium subcrenatum*, *Spirogyra rivularis* (?), *Chroococcus minor*, *Phormidium tenue*, *Trachelomonas volvocina*, *Cyclotella operculata*, *Gomphonema lanceolatum*, *Synedra* spp., *Cymbella* sp., *Navicula producta*, *N. viridula*.)

78. Slime on stagnant water of marsh, Malan, Willowvale District, February 11, 1913. (Mainly iron-bacteria, with fragments of *Spirogyra*, *Cladophora*, and Blue-green Algae.)

79. On rock, over which Ngadu River runs, Malan, Willowvale District, February 10, 1913. (*Cladophora glomerata*, *Phormidium autumnale*, *Synedra pulchella*, *Nitzschia sigmoidea*, *Gomphonema acuminatum* forma.)

81. Clinging to damp rock, Malan, Willowvale District, February 11, 1913. (*Phormidium laminosum*, *Calothrix* sp.)

82. On rock over which Ngadu River runs, Malan, Willowvale District, February 10, 1913. (*Phormidium autumnale*, *Nostoc caeruleum*, *Synedra pulchella*.)

84. Slime on rock over which water has been running, Malan, Willowvale District, February 10, 1913. (*Phormidium autumnale*.)

85. In standing water, Malan, Willowvale District, February 11, 1913. (*Closterium moniliferum*, *C. pritchardianum* forma, *Spirogyra decimina* f. *fuellebornei*, *Zygnema* sp., *Aphanothece microscopica*, *Phormidium tenue*, *Nostoc muscorum*, *Calothrix* sp. (*adscendens* ?), *Synedra ulna*.)

86. In slow-running water of marsh, Malan, Willowvale District, February 11, 1913. (Fragments of *Nitella* with *Oedogonium* sp., *Bulbochaete* sp., *Cosmarium hammeri* and var. *africanum* n. var., *C. capense*, *C. laeve*, *C. punctulatum*, *C. quadrum* var. *minus*, *Spirogyra* sp., *Zygnema* sp., *Tribonema bombycinum* f. *minor*, *Oscillatoria brevis*, *Synedra* spp., *Eunotia lunaris*, *Gomphonema angustatum*.)

87. In marshy ground, Malan, Willowvale District, February 11, 1913. (*Nostoc* sp.)

99. Half-stagnant pool, sheltered by trees, Kentani, February 1, 1913. (*Gonium pectorale*, *Eudorina elegans*, *Euglena* sp., *Synedra ulna*, *Nitzschia acicularis*.)

100. Rain-washed ground, where grass has been removed, Kentani, March 29, 1913. (*Phormidium flaccidum*.)

158. In pools, Quingolo, Mqanduli District, December 23, 1913. Red deposit due to iron-bacteria. (*Chlamydomonas* sp., *Scenedesmus quadricauda* var. *horridus*, *Closterium pegleri* n. sp., *Cosmarium granatum*, *C. capense*, *C. laeve* forma, *Chroococcus turgidus*, *Coelosphaerium kuetsingianum*, *Oscillatoria limosa*, *Trachelomonas hispida*, *Synedra ulna*, *Cymbella helvetica*, *Gyrosigma acuminatum*, *Rhopalodia gibba*, *Surirella ovalis* forma, *Stauroneis acuta*, *Pinnularia dactylus*, *Navicula vulpina*, *N. viridula*, *N. ovalis*.)

159. In pools, Quingolo, Mqanduli District, December 23, 1913. (*Pediastrum integrum* var. *pearsoni*, *Scenedesmus quadricauda* var. *horridus*, *Coelastrum microporum*, *Dictyosphaerium pulchellum*, *Spirogyra* sp., *Oedogonium pringsheimii*, *Bulbochaete* sp., *Closterium pegleri* n. sp., *Cosmarium botrytis*, *Staurostrum striolatum*, *Zygnema* sp., *Chroococcus turgidus*, *Gloeotheca* spp., *Gomphosphaeria aponina*, *Merismopedia glauca*, *M. punctata*, *Phormidium valderianum*, *Synedra pulchella*, *Cymbella* spp., *Denticula denticula*, *Achnanthes exilis*, *Gomphonema gracile* var. *dichotoma*, *Surirella ovalis*, *Epithemia zebra*, *Stauroneis acuta*, *Navicula vulpina*, *Cymatopleura solea*.)

160. On dry rocks, within reach of swollen river, Quingolo, Mqanduli District, December 23, 1913. (Fragments of *Nitella* with *Synedra pulchella* and *Cymbella cymbiformis*.)

161. Stagnant pool, Umtata Park, January 10, 1914. (*Oscillatoria* spp., *Euglena* spp., *Synedra ulna*, *Nitzschia palea*, *N. stagnorum*, *N. tryblionella*, *Surirella ovalis*, *Navicula exilis*, *N. mutica*.)

311. On decayed *Typha* in exposed stream, Quingolo, Mqanduli District, October 21, 1916. (*Gloeocystis vesiculosa*, *Pediastrum* spp., *Scenedesmus bijugatus*, *Geminella interrupta*, *Chaetosphaeridium globosum*, *Oedogonium varians* (?), *Bulbochaete* sp., *Cosmarium* spp., *Spirogyra* sp., *Zygnema cyanospermum* forma, *Mougeotia* sp., *Chroococcus turgidus*, *Merismopedia glauca*, *Peridinium* sp., and various Diatoms.)

312. Exposed stream, Quingolo, Mqanduli District, October 21, 1916. (Same as last with *Scenedesmus quadricauda* and var. *dispar*, *Closterium moniliferum*, *Cosmarium meneghinii* f. *africana*, *C. sportella* var. *simplex* n. var., *Zygnema* sp., *Gomphosphaeria aponina*, *Oscillatoria animalis*, *Trachelomonas volvocina*.)

313. Exposed stream, Quingolo, Mqanduli District, October 21, 1916. (*Spirogyra* sp. with *Cymatopleura* and other Diatoms.)

314. Exposed stream, Quingolo, Mqanduli District, October 21, 1916. (Similar to 312, though with fewer species.)

315. Floating dark slime, in exposed stream, Quingolo, Mqanduli District, October 21, 1916. (Similar to 312, but with fewer species. Also present: *Closterium leibleinii*, *Nitzschia acicularis* and other species, *Gyrosigma acuminatum*.)

316. Exposed stream, Quingolo, Mqanduli District, October 21, 1916, (*Spirogyra decimina* var. *inflata* n. var., *Spirogyra* sp., *Zygnema* sp., and a few Diatoms.)

323. On water-plants in brackish water, Gogwana mouth, April 1, 1915. (*Enteromorpha basiramosa* n. sp., *Cladophora* sp., and numerous Diatoms.)

324. In exposed pool, formed by spring-water trickling on to beach, Kentani, April 1, 1915. (*Chroococcus turgidus*, *Gloeothece linearis*, *Microcystis* spp., *Oscillatoria* spp., *Phormidium fragile*, *Lyngbya aestuarii*, *Microcoleus chthonoplastes*, *Anabaena torulosa*, *Gyrosigma* sp., *Amphora* sp. and numerous other Diatoms.)

325. On rocks, where spring-water meets sea-water, Kentani, April 3, 1915. (*Enteromorpha basiramosa* n. sp., *Cladophora* sp., *Gomphosphaeria aponina*, *Chamaesiphon incrustans*, and numerous Diatoms.)

326. About fifty yards from the mouth of the Qolora River, Kentani, April 3, 1915. (*Chroococcus* spp., *Gomphosphaeria aponina*, *Oscillatoria* spp., *Spirulina major*, *Phormidium subfuscum*, *Melosira* sp., and other Diatoms.)

327. Slightly exposed stream at an altitude of 1200 ft., Kentani, March 24, 1915. (*Pediastrum te'ras*, *Ankistrodesmus falcatus*, *Coleochaete scutata*, *Oedogonium* spp., *Penium margaritaceum* var. *irregularius*, *Closterium* spp., *Pleurotaenium* spp., *Euastrum simpliciforme* n. sp., *Cosmarium pachydermum* var. *tuberculatum* n. var., *C. undulatum* var. *crenulatum* *C. hammeri* var. *africana* n. var., *C. granatum* forma and var. *africanum* n. var., *C. capense*, *C. regnellii* forma, *C. laeve* formae, *C. subprotumidum* and subsp. *simplex* n. subsp., *C. botrytis* var. *pegleri* n. var., *C. gayanum* var. *rotundata* n. var., *C. quadrum* forma, *Spirogyra bellis*, *Spirogyra* sp., *Zygnema* sp., *Mougeotia* sp., *Anabaena* sp., *Scytonema (stuposum?)*, *Calothrix gracilis* f. *flexuosa*, *Synedra ulna* var. *splendens*, *Stauroneis phoenicenteron*, *Navicula ovalis*, and numerous other Diatoms.)

328. Slow-running stream in the shade, Kentani, April 10, 1915. (Only iron-bacteria.)

329. On floating *Phragmites* stem, about a mile from the mouth of the Qolora, Kentani, April 18th, 1915. (Fragments of *Enteromorpha basiramosa* n. sp., *Rhizoclonium hieroglyphicum*, *Cladophora* sp., *Oedogonium* sp., *Closterium ehrenbergii* (?), *Lyngbya aerugineo-coerulea*, *Calothrix* sp., and Diatoms.)

330. On floating *Phragmites* stem, about a mile from the mouth of the Qolora, Kentani, April 18, 1915. (*Enteromorpha basiramosa* n. sp., *Oedogonium* sp., and Diatoms.)

331. On sheltered stones, in clear, running water, Kentani, about 1200 ft., April 19, 1915. (*Scenedesmus quadricauda*, *Oedogonium* spp., *Cosmarium quadrum* forma, *Spirogyra fluviatilis* var. *africana* n. var., *Chamaesiphon incrustans*, and Diatoms.)

332. Scrapings off wood and stone, near homestead, Kentani, about 1200 ft., May 2, 1915. (*Pleurococcus vulgaris*, *Hormidium flaccidum*.)

333. Marshy ground, Kentani, 1200 ft., May 1, 1915. (Diatoms only.)

334. Marshy ground, Kentani, 1200 ft., May 1, 1915. (*Oedogonium* sp., *Vaucheria* sp., *Closterium* spp., *Tribonema bombycinum* f. *minor*, and Diatoms.)

335. Exposed clear running stream, Kentani, altitude 1200 ft., May 5, 1915. (*Oscillatoria subtilissima*, *Nostoc* sp. (*verrucosum*?) *Calothrix* sp.)

336. Sheltered marshy spot, Kentani, about 1200 ft., May 2, 1915. (*Closterium* spp., *Cosmarium quadrum* forma, *Spirogyra* sp., *Oscillatoria tenuis*, *Chantransia chalybea*, and Diatoms.)

337. Stagnant pool, near stream, Kentani, 1200 ft., May 24, 1915. (*Closterium moniliferum*, *Synedra ulna*.)

338. Open vlel near Gogwana mouth, July, 1915. (*Sphaerocystis schroeteri*, *Ulothrix subtilissima*, *Closterium* spp., *Spirogyra subreticulata* n. sp., *Ophiocytium* spp., *Phacus* spp., *Eunotia lunaris*, *Fragilaria* sp., and other Diatoms.)

339. The same, epiphytes on *Nitella* and other water-plants. (Similar to 338, but with *Pleurococcus dissectus*, *Bulbochaete* sp.)

340. The same. (Similar to 338, but with *Trochiscia stagnalis*, *Euglena* sp.)

341. Slow-running stream, near Gogwana mouth, July, 1915. (*Oedogonium* sp., *Cosmarium meneghinii*, and Diatoms.)

342. Sheltered mouth of slow stream near Gogwana mouth, July, 1915. (*Oedogonium* sp., *Tribonema bombycinum* f. *minor*, *Synedra* spp., and other Diatoms.)

343. The same, on dead leaves. (*Coleochaete orbicularis*, and a few Diatoms.)

344. Trickle of water on road, passing through small wood, N'quamakwe, 2500 ft., June 27, 1917. (*Vaucheria sessilis* f. *repens*, *Spirogyra* sp., *Synedra* spp., *Achnanthes* spp., *Surirella* sp., etc.)

345. Scrapings from side of tank, containing spring-water, N'quamakwe, 2500 ft., July 5, 1917. (*Chlorococcus* sp. (? Fig. 1), *Pediastrum tetras* var. *apiculatum* n. var., *Oocystis rupestris*, *Scenedesmus bijugatus*, *Ulothrix variabilis*, *Cosmarium* spp., *Schizothrix calcicola*, *Calothrix* sp., and Diatoms.)

346. Roadside puddle formed by drying surface spring, N'quamakwe, 2500 ft., July 5, 1917. (*Closterium pritchardianum* forma, *C. pseudolibellula* n. sp., *Tribonema bombycinum* f. *minor*, *Oscillatoria geminata*, *Euglena* sp.)

Previous records for South Africa are given under the individual species. The number of new records for South Africa in the present communication is seventy-two.

C. SYSTEMATIC ENUMERATION OF THE SPECIES OBSERVED.

1. ISOKONTAE.

(a) CHLAMYDOMONADALES.

(2) CHLAMYDOMONADACEAE.

GENUS CHLAMYDOMONAS EHRENBERG.

(NOTE.—Individuals of this genus, which were either too scanty or too imperfectly preserved to render determination possible, were observed in samples 31—here as a very abundant *Palmella*-stage—and 158.)

(5) VOLVOACEAE.

GENUS GONIUM MUELLER.

1. *Gonium pectorale*, Mueller, Verm. terrestr. et fluviat., etc., i, 1773, p. 60.

Sample 99 (very rare).

GENUS EUDORINA EHRENBERG.

1. *Eudorina elegans*, Ehrenberg, Infusionsthier, 1851, p. 78, Pl. II, fig. 10.

Sample 99 (rare).

Previously recorded from Cape Colony and Orange Free State (Fritsch).

(c) TETRASPORALES.

(1) SPHAEROCYSTACEAE.

GENUS SPHAEROCYSTIS CHODAT.

1. *Sphaerocystis schroeteri*, Chodat, Études d. Biol. lacustre, Bull. d. l'Herb. Boissier, 1897, p. 292, Tab. IX; Alg. vert. de la Suisse, Berne, 1902, p. 114, fig. 53.

Samples 338, 339 (rare).

Previously recorded from Cape Colony (Fritsch).

(3) PALMELLACEAE.

GENUS GLOEOCYSTIS NAEGLI.

1. *Gloeocystis infusionum* (Schränk), G. S. West, Brit. Freshw. Algae, 1904, p. 246, fig. 113, A-E. (Syn.: *Chlorococcum infusionum* (Schränk), Menegh.)

Samples 20, 21 and 24.

2. *Gloeocystis vesiculosa*, Naegeli, Gatt. einzell. Alg., 1849, p. 65, 66, Tab. IV, F.

Samples 311, 312.

(d) PROTOCOCCALES.

(1) CHLOROCOCCACEAE.

GENUS CHLOROCOCCUM FRIES.

1. *Chlorococcum* sp. (?) (Fig. 1).

Sample 345 (common).

This form occurred in the shape of isolated, generally completely spherical cells, of rather varying dimensions (diam. 20–36 μ). The wall in most cases was moderately thick, with a well-defined outer “cuticle,” but now and again cells were encountered with a much thicker stratified membrane (Fig. 1, *A*). The cell-contents not uncommonly occupied the whole interior (Fig. 1, *A*); some of the cells, however, possessed more or less contracted contents and, in such cases, one or more oil-drops were almost invariably present between the wall and the protoplast (Fig. 1, *B*). In many of the cells a small spherical body was visible in the middle of the protoplast (Fig. 1, *A* and *B*). This appeared to be the nucleus, since

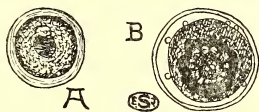


FIG. 1.—*Chlorococcum* sp. (?). *A*, cell with thick stratified wall, showing the central nucleus (?). *B*, cell with contracted contents, showing small oil-drops and ring of starch near centre of contents. $\times$ 650.

starch was not detected in the immediate vicinity. Pyrenoids seemed to be absent, but there was commonly a ring-shaped zone of starch (Fig. 1, *B*), lying about midway between the surface of the protoplast and the centre of the cell. The chloroplast was difficult to decipher, but such indications as were obtainable hint at its being spherical. For this reason this form is provisionally referred to the genus *Chlorococcum*, although in the absence of all reproductive stages the reference must remain doubtful.

(4) HYDRODICTYACEAE.

GENUS PEDIASTRUM MEYEN.

1. *Pediastrum tetras* (Ehrenb.), Ralfs, Ann. and Mag. Nat. Hist., xiv, 1844, p. 469, Pl. XII, fig. 4; Brit. Desm., 1848, p. 182, Tab. XXXI, fig. 1. (Syn.: *P. ehrenbergii* Corda.)

Samples 311, 312, 327, 345.

Never very abundant; 4–8-celled colonies.

Previously recorded from Cape Colony (Fritsch).

Var. *apiculatum*, F. E. Fritsch, nov. var. (Fig. 2).

Coenobii e cellulis 4 vel 8 (disp.: 7-1) constantibus; cellulis marginalibus processibus 2 plus minus divergentibus, in apice paullo dilatatis et membrana incrassata; inter cellulas marginales membrana exterior saepe est incrassata et plus minus prominens forma apiculi. Lat. colon. 4-cell., $22\ \mu$; lat. colon. 8-cell., $24-40\ \mu$; lat. cell., $9-16\ \mu$.

Samples 71 (rare) and 345 (rather rare).

It is possible that this should be regarded as a separate species, but the relatively little material available was not sufficient to settle this point. In particular the four-celled stage (Fig. 2, D), bears, except for the characteristic apiculus at the end of each marginal process, a considerable

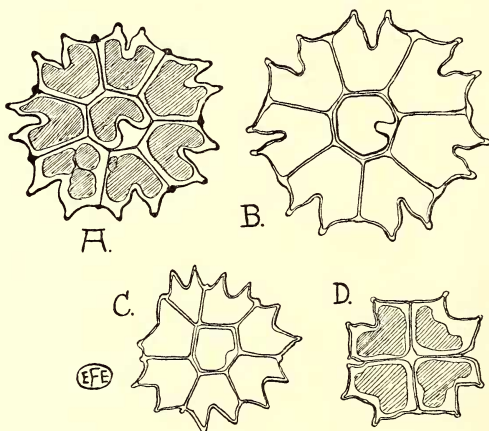


FIG. 2.—*Pediatrum tetras* (Ehrenb.), Ralfs, var. *apiculatum*, F. E. Fritsch, nov. var. A and B, eight-celled, D, four-celled colonies; C, abnormal colony. $\times 1000$.

resemblance to some of the simpler colonies of *P. tetras* (cf. especially Ralfs, *loc. cit.*, Tab. XXXI, fig. 1, D). It is to be noticed that the depth of the incision between the marginal processes, as well as the shape of the latter, are rather variable. On the whole the incision tends to be wider and blunter than in the type; this applies also to the single, centrally placed, cell of the eight-celled colonies.

A second characteristic of the variety, apart from the apiculate processes, lies in the presence of a more or less marked thickening of the external membrane at a point coinciding with the septum between two marginal cells (Fig. 2, A, B, C); in some cases this thickening is so marked as to amount to a definite projection.

2. *Pediastrum integrum*, Naegeli, *op. cit.*, pp. 96, 97, Tab. V, B, fig. 4.
var. *pearsoni* (G. S. West), F. E. Fritsch. (Syn.: *P. pearsoni*, G. S. West, *Freshw. Algae*, Percy Sladen Memorial Exped., etc., *Ann. S. Afr. Mus.*, ix, 1912, p. 79, figs. 30-32.) (Fig. 3.)

Samples 159, 311, 312, 314, 315 (especially common in 312).

An examination of the extensive material in the present samples has shown that *P. pearsoni* is not sufficiently distinct from *P. integrum* to

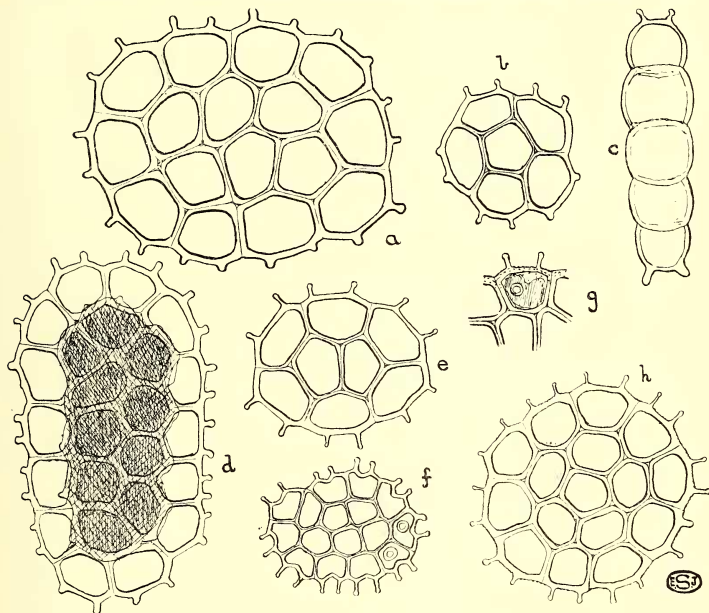


FIG. 3.—*Pediastrum integrum*, Naeg., var. *pearsoni* (G. S. West), F. E. Fritsch.
c in side view; in *g* the chloroplast and scrobiculation of the cell-wall are shown; in *d* the superincumbent cells are shaded. *f*, young colony (?).
All figures $\times 600$.

warrant the establishment of a separate species. The only marked points of difference are: (a) the subcapitate character of the short processes borne by the marginal cells—a feature which is not always pronounced (*cf.* Fig. 3, *a* and *d*); (b) the fact that these processes are not situated in the same plane (*cf.* especially fig. 3, *c* and West's fig. 31); (c) the minute scrobiculation of the membrane. As minor points of difference may be noted the not uncommon elliptical shape of the cells (Fig. 3, *e*, and West's fig. 30).

which are, however, often isodiametric as in the typical *P. integrum*, and a tendency towards rounding off of the angles.

Other features of West's diagnosis do not hold good. Thus, the colonies are by no means always elliptical in outline (*cf.* Fig. 3, *a*, *e*, and *h*), and the number of component cells is subject to very considerable variation, as a reference to the figures will show; colonies consisting of 15 cells have not, however, been observed, and this is perhaps an abnormal condition. The following numbers and arrangements of the cells were encountered: 6 (5-1), 8 (6-2), 16 (10-6, 11-5, 10-5-1, 9-6-1); colonies with still more numerous cells, not uncommonly arranged in two layers, are not infrequent (Fig. 3, *d*).

The type of colony, shown in Fig. 3, *f*, is probably to be regarded as a young stage. It differs from the others in the smaller size of its cells, and in the fact that the outer edge of the marginal cells, between the two processes, is usually markedly retuse. Slight indications of this retuse character are at times to be found even in the large-celled colonies. It is noticeable that in this small-celled form the processes have attained their full dimensions.

(5) CHLORELLACEAE.

GENUS TROCHISCIA KUETZING.

1. *Trochiscia stagnalis*, Hansgirg, Prodr. d. Algenfl. v. Boehmen, ii, 1892, p. 241. (Syn.: *Acanthococcus palustris*, Hansgirg, *op. cit.*, i, 1888, p. 274.)
Sample 340 (very rare).

GENUS TETRAEDRON KUETZING.

1. *Tetraedron minimum* (A. Br.), Hansgirg, Ueb. d. Suesswasseralg.-Gatt. *Trochiscia*, etc., Hedwigia, xxvii, 1888, p. 131. (Syn.: *Polydrium minimum*, A. Br.)

Sample 71.

Previously recorded from the Karoo and Little Namaqualand (G. S. West).

(6) OOCYSTACEAE.

GENUS OOCYSTIS NAEGELI.

1. *Oocystis solitaria*, Wittrock, in Wittr. et Nordst., Alg. exsicc., No. 244, Bot. Notiser, 1879, p. 27; Printz, Uebers. ueb. d. Gatt. *Oocystis*, Nyt Mag. f. Naturvidenskab., li, 1913, p. 183, Tab. V, figs. 36-39.

Sample 36.

Long. cell., 23-25 μ ; lat., 12-16 μ .

Previously recorded from Cape Colony and Orange Free State (Fritsch).

2. *Oocystis rupestris*, Kirchner, Beitr. z. Algenfl. v. Wuerttemberg, Jahreshefte d. Ver. f. vaterl. Naturk. in Wuerttemberg, xxxvi, 1880, p. 169, Tab. II, fig. 2; Printz, *op. cit.*, p. 174, Tab. IV, figs. 7-9.

Sample 345.

Previously recorded from Cape Colony (Fritsch).

(7) SCENEDESMACEAE.

GENUS SCENEDESMUS MEYEN.

1. *Scenedesmus quadricauda* (Turp.), Brébisson, Alg. Falaise, 1835, p. 66; Brunnthaler, Syst. Uebers. *Scenedesmus*, Hedwigia, liii, p. 168, fig. 16. Forma *typica*.

Samples 71, 312, 331.

Var. *abundans*, Kirchner, Kryptogamenfl. Schlesien, ii, 1878, p. 98; Brunnthaler, *op. cit.*, p. 168, fig. 18.

Sample 71.

Var. *dispar* (Bréb.), Brunnthaler, *op. cit.*, pp. 168, 171. (Syn.: *S. dispar*, Bréb.)

Sample 312.

Var. *horridus*, Kirchner, *op. cit.*, p. 98; Brunnthaler, *op. cit.*, p. 168.

Samples 158, 159.

The type and var. *dispar* previously recorded from Cape Colony (Fritsch); the type from the Karoo, Holle River, and Little Namaqualand (G. S. West).

2. *Scenedesmus bijugatus* (Turp.), Kuetzing, Synops. Diat., Linnaea, viii, 1833, p. 607. (Syn.: *S. obtusus*, Meyen.)

Samples 311, 345.

Previously recorded from Cape Colony (Fritsch), the Karoo and Little Namaqualand (G. S. West).

GENUS COELASTRUM NAEGELI.

1. *Coelastrum microporum*, Naegeli, in A. Braun, Alg. unicell., etc., 1855, p. 70.

Sample 159.

Previously recorded from Cape Colony (Fritsch).

f. *irregulare*, F. E. Fritsch, Freshw. Alg. S. Orkneys, Journ. Linn. Soc., Bot., xl, 1912, p. 328, fig. H.

Sample 312.

GENUS DICTYOSPHAERIUM NAEGELI.

1. *Dictyosphaerium pulchellum*, Wood, Freshw. Alg. N. America, Smithsonian Contrib., xix, No. 241, 1872, p. 84, Pl. X, fig. 4.

Sample 159 (very rare).

GENUS ANKISTRODESMUS CORDA (RHAPHIDIUM KUETZ.).

1. *Ankistrodesmus falcatus* (Corda), Ralfs, Brit. Desm., 1848, p. 180. (Syn.: *Rhaphidium fasciculatum*, Kuetz.; *R. polymorphum*, Fresen., var. *falcatum*, Rabenh.)

Sample 327 (rare).

Previously recorded from Cape Colony and Orange Free State (Fritsch).

Addendum: Genus of doubtful position. PLEUROCOCCLUS Menegh.

1. *Pleurococcus vulgaris*, Meneghini, Monogr. nostoch. Ital., Att. R. Acad. Sci. Torino, ser. 2, v, 1842, p. 38, Pl. V, fig. 1.

Sample 332.

2. *Pleurococcus dissectus* (Kuetz.), Naegeli, Gatt. einzell. Alg., 1849, p. 65, Tab. IV, e, fig. 3. (Syn.: *Protococcus dissectus*, Kuetz.)

Sample 339 (attached to various substrata, especially common on *Utricularia* sp.).

This species is evidently of wide distribution in the Southern Hemisphere. It has been recorded by G. S. West from Angola and plays an important part in the Antarctic algal flora. In all these cases, as in the present instance, the species grows submerged, whereas in other regions it is subaërial.

(e) ULOTRICHALES.

(1) ULOTRICHACEAE.

GENUS ULOTHRIX KUETZING.

1. *Ulothrix subtilissima*, Rabenhorst, Krypt. Flora v. Sachsen, etc., I, 1863, p. 263; Heering, Ulotrichales, etc., in Pascher, Suesswasserfl. Deutschlands, etc., vi, 1914, p. 32, fig. 27.

Samples 338, 339, 340 (in all cases rare).

Previously recorded from Cape Colony (Fritsch).

2. *Ulothrix tenerrima*, Kuetzing, Phyc. gen., 1843, p. 253, Pl. IX, fig. 1; Heering, *op. cit.*, p. 32, figs. 28-30.

Samples 20, 21, 28, 29.

Previously recorded from Little Namaqualand (G. S. West).

3. *Ulothrix variabilis*, Kuetzing, Spec. Alg., 1849, p. 346; Heering, *op. cit.*, p. 32, fig. 27.

Sample 345 (common).

Previously recorded from Cape Colony (Fritsch).

4. *Ulothrix moniliformis*, Kuetzing, Spec. Alg., 1849, p. 347; Heering, *op. cit.*, p. 33, fig. 32.

Sample 24 (?).

Cells definitely constricted; diam. 14–15 μ .

[NOTE.—Fragments of a species of this genus were also present in sample 17.]

GENUS HORMIDIUM KLEBS.

1. *Hormidium flaccidum*, A. Braun; Heering, *op. cit.*, p. 46, figs. 48, 49.

Samples 100, 332 (in the latter case rather fragmentary).

GENUS GEMINELLA TURPIN.

1. *Geminella interrupta*, Turpin, Mém. d. Mus. d'hist. nat., xvi, 1828, p. 329, Tab. XIII, fig. 24; Heering, *op. cit.*, p. 41, fig. 45.

Samples 311, 312, 314 (rather common in 311).

Lat. cell., 6–7 μ ; long. cell., ad 15 μ ; lat. vag., ad 33 μ .

(2) ULVACEAE.

GENUS ENTEROMORPHA LINK.

1. *Enteromorpha basiramosa*, F. E. Fritsch, n. sp. (Figs. 4, 5).

E. parva, ad 2 cm. longa, rupibus vel plantis aquaticis adhaerens; thallo angustissimo tubuloso, ad basin copiose insuper parcellissime ramoso, ramis in parte superiore plerumque brevibus uni- vel raro bi-seriatis; filis primariis usque ad 500 μ crassis, flexuosis, apicibus plerumque abruptis, sed interdum in cellula singula terminatis, cellulis saepe in seriebus longitudinalibus distinctis, interdum leviter spiralibus, dispositis, sed in filis latissimis sub-irregulariter ordinatis; cellulis non elongatis formae variabilis, in filis latissimis cytoplasmate saepe in membranam exteriorem incrassatam papilliforme porrecto, pyrenoidibus 1–2; discus adhaerens flabelliformis e seriebus arctis radiantibus cellularum angustarum constans.

Lat. fil. prim., 45–500 μ ; lat. ram. 1–2 seriatis, 15–18 μ ; crass., cell., 7–12 μ .

Samples 323, 325, 330.

This species appears to occur not uncommonly in the brackish water near the mouths of the rivers in Kentani. None of the thalli in the three samples reached any considerable dimensions, but some at least seemed to present the mature condition. *E. basiramosa* therefore belongs to the *Entero-*

morphas of small stature, such as *E. minima*, Naeg., *E. aureola* (Ag.), Kuetz., and *E. fucicola* (Menegh.), Kuetz.

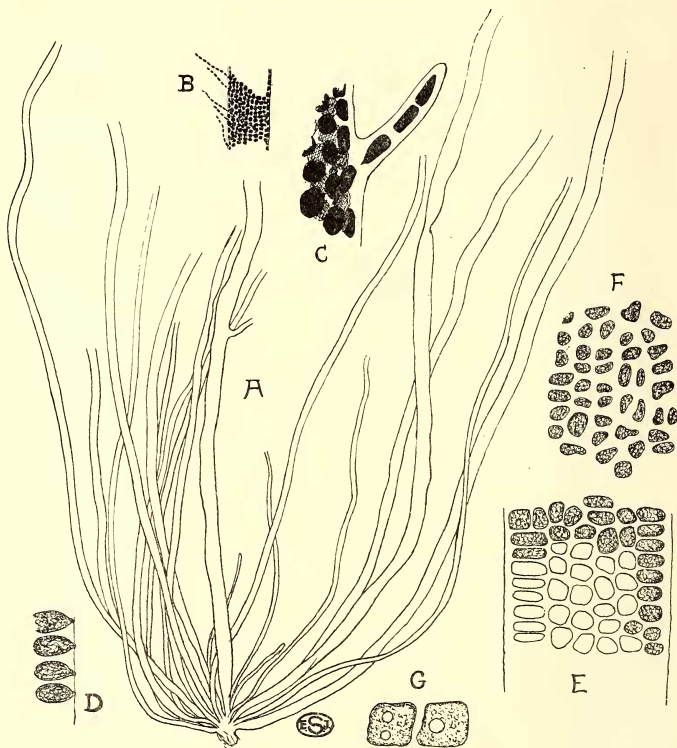


FIG. 4.—*Enteromorpha basiramosa*, F. E. Fritsch, n. sp. *A*, single thallus, enlarged about twenty times. *B*, part of the upper portion of one of the primary filaments, showing the small uniseriate branches. *C*, small part of the same on a larger scale. *D*, cells, seen in optical section, from the margin of one of the wider filaments, showing the papilla-like protrusion of the protoplasm into the thickened outer wall. *E*, and *F*, parts of older filaments showing the disposition of the cells. *G*, single cells. *B* $\times 100$; *C*–*F* $\times 450$; *G* $\times 700$.

The most marked characteristic of the new species lies in the abundant branching that takes place just above the base of the plant (Fig. 4, *A*, and

Fig. 5). The lower part of the thallus of a mature specimen is a broad structure passing over gradually, on the one hand into the fan-shaped attaching organ (Fig. 5), and on the other hand into the numerous branches that arise just above the base (Figs. 4, *A*, and 5). The organ of attachment is composed of closely apposed, more or less radiating rows of rather narrow and elongated cells (Fig. 5). The cells in the thallus proper are never markedly elongated, but apart from that vary much in shape. In part they are approximately isodiametric, as seen from the surface, in part somewhat drawn out in the transverse or longitudinal direction (Fig. 4, *E-G*). In optical section, at the edge of the thallus, they either appear elongated at

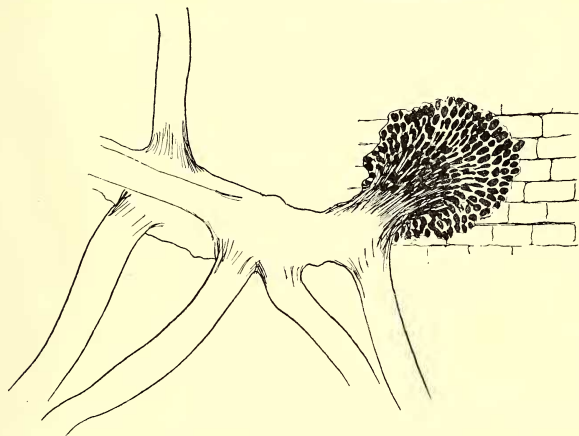


FIG. 5.—*Enteromorpha basiramosa*, F. E. Fritsch, n. sp. Attaching base and lower portion of a mature thallus. $\times 40$.

right angles to the surface or somewhat flattened. As shown in Fig. 4, *E* and *F*, the shape of the cells may vary appreciably, even in small parts of a thallus. In the vast majority of cases the cells are arranged in very obvious longitudinal rows (Fig. 4, *B* and *E*), which were sometimes observed to have a slight spiral trend. In the broadest filaments, however, this regular disposition, though still recognisable, may become somewhat obscured (Fig. 4, *F*). The outer wall of the cells is markedly thickened—more so than the side walls (Fig. 4, *E*). Especially in the wider threads, the protoplast appears not uncommonly to protrude in a papillate manner into the thickened outer wall (Fig. 4, *D*). The cells have one or two pyrenoids (Fig. 4, *G*).

Apart from the abundant branching just above the base, the production of larger branches in the upper part of the thallus is rare (cf. Fig. 4, *A*).

At certain points, however, there occur numerous fine branches composed of one, or more rarely of two, rows of cells (Fig. 4, *B*, *C*). These branches are quite short, run to a point, and do not branch further. They are very erratic in their occurrence, whole areas of the thalli being completely devoid of them. The large main branches of the thallus were almost invariably broken off or dead at the tips (Fig. 4, *A*), but when the actual end was present it was always pointed, the branch terminating in a single cell. The main filaments gradually widen to a slight extent from the base upwards, but retain a rather even edge (Fig. 4, *A*); in a few cases the distal end was irregular in shape.

(6) CLADOPHORACEAE.

GENUS RHIZOCLONIUM Kuetzing.

1. *Rhizoclonium hieroglyphicum* (Kuetz.), Stockmayer, Ueb. d. Algengatt. *Rhizoclonium*, Verh. k. k. Zool.-Bot. Ges. Wien, xl, 1890, p. 578; Kuetzing, Phyc. germ., 1845, p. 206.

Sample 329 (common).

Previously recorded from South Africa (Wille) and Cape Colony (Fritsch).

GENUS CLADOPHORA Kuetzing.

1. *Cladophora glomerata* (L.), Kuetzing, Phyc. germ., 1845, p. 212.

Sample 79.

A form in which the membrane of the cells was provided with distinct longitudinal folds. Very faint striations were also often recognisable, so that there is some resemblance to var. *ornata*, Lemmermann ('Forschungsber. Biol. Stat. Ploen,' 1895, sep. copy, p. 35, fig. 8), in which, however, the striae are more pronounced.

Previously recorded from Orange Free State (Fritsch).

(NOTE.—Undeterminable material of this genus was also present in samples 323, 325, and 329.)

(f) CHAETOPHORALES.

(1) CHAETOPHORACEAE.

GENUS STIGEOCLONIUM Kuetz (MYXONEMA FRIES).

1. *Stigeoclonium falklandicum*, Kuetzing, Tab. Phyc., III, 1853, t. 2.

Samples 70 (?), 71 (?).

A form showing a certain amount of constriction between the cells, but otherwise agreeing with the diagnosis of this little-known species. Most of

the cells were not more than two or three times as long as broad. *Myxonema attenuatum*, Hazen ('Mem. Torrey Bot. Club,' xi, 1902, p. 206, pl. xxxv) comes very close to the form in question, except as regards the constriction between the cells, and it may be doubted if it is more than a variety of *S. falklandicum*.

(2) CHAETOSPHAERIDIACEAE.

GENUS CHAETOSPHAERIDIUM KLEBAHN.

1. *Chaetosphaeridium globosum* (Nordst.), Klebahn, Pringsh. Jahrb., xxv, 1893, p. 306, Tab. XIV, figs. 5-10. (Syn.: *Herpoteiron globosa*, Nordst.; *Aphanochaete globosa*, Wolle.)

Samples 311, 312.

Previously recorded from Cape Colony (Fritsch).

(4) COLEOCHAETACEAE.

GENUS COLEOCHAETE BRÉBISSE.

1. *Coleochaete scutata*, Brébisson, Ann. sci. nat., sér. 3, Bot., i, 1844, p. 29, Pl. II, figs. 1-7.

Sample 327 (on fragments of leaves and on the filaments of *Spirogyra bellis* (Hass.), Cleve.)

Previously recorded from Cape Colony and Orange Free State (Fritsch).

2. *Coleochaete orbicularis*, Pringsheim, Beitr. z. Morph. u. Syst. d. Algen, iii, Pringsh. Jahrb., ii, 1860, p. 11, Pl. I, fig. 5, etc.

Sample 343 (on dead leaves).

(g) OEDOGONIALES.

(1) OEDOGONIACEAE.

GENUS OEDOGONIUM LINK.

1. *Oedogonium pusillum*, Kirchn.; Hirn, Monogr. u. Iconogr. d. Oedogoniaceen, 1900, p. 299, Tab. XXIV, fig. 125. (Syn.: *O. africanum*, Lagerh.; *O. klebahnii*, Lemm.)

Forma paullo major, lat. cell. veg., 6-7.5 μ ; lat. oogon., 20-21 μ ; long. oogon., 27-33 μ .

Sample 36.

In view of the scanty nature of the material and of the absence of ripe oospores, the reference of this form to *O. pusillum* is somewhat doubtful. Except for the larger dimensions, however, all the characters agreed with the diagnosis in Hirn. The oogonia were biconical-ellipsoid, with a wide median operculum, and the basal cell was hemispherical. Neither antheridia nor dwarf males were encountered, so that the present observations support the view that this species is dioecious and macrandrous. *O. pusillum* has been recorded from Abyssinia by Lagerheim.

2. *Oedogonium pringsheimii*, Cramer; Hirn, *op. cit.*, p. 170, Tab. XXVII, fig. 155.

Sample 159.

Diam. cell. veg., 15 μ , altit. usque 4-5-plo major; diam. oogon., 39 μ .

Previously recorded from Little Namaqualand (G. S. West).

3. *Oedogonium* sp. (*O. varians*, Wittr. et Lund.; Hirn, *op. cit.*, p. 89, forma?).

Samples 311, 312.

Only sterile filaments and such as bore oogonia were observed. The form thus appears to be dioecious—a condition which is not unknown in *O. varians* (cf. Hirn, p. 90). The oogonia were often pyriform, but in a few cases the shape was more elliptical; there was an almost superior pore which was generally difficult to recognise. The basal cell was hemispherical which is not the type hitherto recorded for *O. varians*. The dimensions were: Lat. cell. veg., 7-9 μ , long., 27-50 μ ; lat. oogon., 22-27 μ , long., 24-30 μ .

(NOTE.—Sterile species of *Oedogonium* were also observed in samples 17, 19, 20, 21, 29, 86, 327, 329, 330, 331, 334, 340, 341, and 342.)

GENUS BULBOCHAETE AGARDH.

(NOTE.—Only sterile material of this genus was present, viz. in samples 86, 159, 311, 339, and 340.)

(h) SIPHONALES.

(2) VAUCHERiaceae.

GENUS VAUCHERIA DE CANDOLLE.

1. *Vaucheria sessilis* (Vauch.), De Candolle; Heering, Suesswasseralg. Schleswig-Holsteins, etc., ii, Jahrb. d. Hamburg. Wiss. Anst., xxiv, 1906, p. 143.

Sample 344 (f. *repens*, Rabenh.).

(NOTE.—Sterile material of this genus was encountered in samples 24, 66, and 334.)

(i) CONJUGATAE.

(1) MESOTAENIACEAE.

GENUS CYLINDROCYSTIS MENEGH.

1. *Cylindrocystis brebissonii*, Menegh.; W. & G. S. West, Monogr. Brit. Desm., i, Ray Society, 1904, p. 58, Pl. IV, figs. 23-32.

Sample 36.

Long., $51\ \mu$; lat., $17\ \mu$.

Var. *minor*, W. & G. S. West, *loc. cit.*, p. 59, Pl. V, fig. 11.

Sample 36.

Long., $36\ \mu$; lat., $12\ \mu$.

(2) DESMIDIACEAE.

GENUS PENIUM BRÉBISSE.

1. *Penium margaritaceum* (Ehrenb.), Bréb.; W. & G. S. West, *loc. cit.*, p. 83, Pl. VIII, figs. 32-35.

Var. *irregularius*, W. & G. S. West, Freshw. Alg. Orkneys and Shetlands, Trans. and Proc. Bot. Soc. Edinburgh, xxiii, 1905, pp. 14, 15, fig. 23 (fig. *nostr.* 6, C).

Sample 327 (not uncommon).

Long. cell., $141-204\ \mu$; lat., $22-25\ \mu$. This form has already been recorded by F. E. Fritsch from the Cape, whilst the type is known from Madagascar. The specimens in the present sample were rather larger, but still appreciably smaller than those originally described by Messrs. West from the Orkneys and Shetlands. Another difference lies in the small size of the granules (Fig. 6, C).

2. *Penium minutum* (Ralfs), Cleve; W. & G. S. West, *loc. cit.*, p. 83, Pl. X, figs. 1, 2.

Var. *productum*, F. E. Fritsch, nov. var. (Fig. 6, D).

P. multo brevior et paullo latior quam typo; cellulis in media parte constrictione exigua late aperta praeditis et paullo ante polos rotundato-truncatos levissime constrictis; membrana glabra, hyalina. Long., $63-65\ \mu$; lat., $18-20\ \mu$.

Sample 36 (rare).

This variety comes near to var. *tumidum*, Wille (*cf.* W. & G. S. West, *loc. cit.*, p. 104, Pl. X, fig. 5), in which, however, the median constriction is more pronounced and the subapical contraction is absent; the latter feature gives the ends of the cells of var. *productum* a protruded appearance. The sides of the semi-cells, however, in both cases converge towards the ends, so that the greatest width is a little way above the base. Borge ("Alg. erst. Regnellschen Exped., ii, Desmid.," 'Arkiv. f. Bot.', i, 1903, Tab. I, fig. 4) has figured specimens of this species under the name of var. *crassum*, West in

which there is also a slight convergence of the sides which are not parallel, as in the typical var. *crassum*. These specimens seem to link up vars. *crassum* and *tumidum*.

GENUS CLOSTERIUM NITZSCH.

1. *Closterium pegleri*, F. E. Fritsch, n. sp. (Fig. 6, B).

C. submediocre; cellulis singulis vel saepe in fasciculos e cellulis numerosis compositos consociatis, semilunaribus, lanceolatis, medio paullo

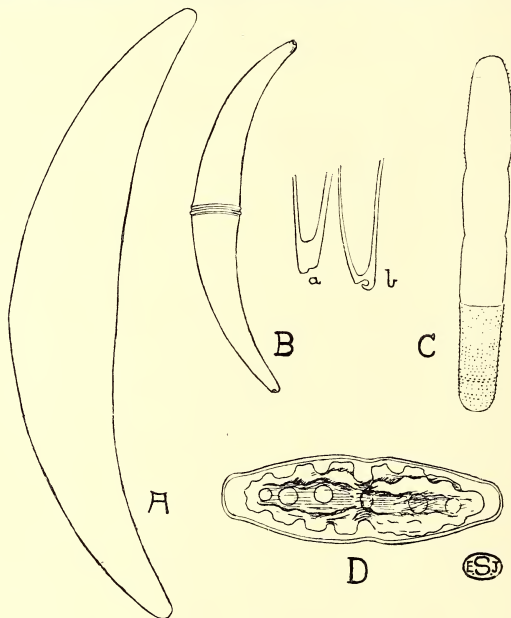


FIG. 6.—A, *Closterium ehrenbergii*, Menegh., var. *concauum*, Schmidle, forma.
B, C, *pegleri*, F. E. Fritsch, n. sp. a and b, the ends of two cells enlarged.
C, *Penium margaritaceum* (Ehrenb.), Bréb., var. *irregularius*, W. & G. S. West.
D, *P. minutum* (Ralfs), Cleve, var. *productum*, F. E. Fritsch, nov. var.
A $\times 225$; B and C $\times 375$; a, b and D $\times 750$.

inflatis, polos versus magis curvatis et sensim attenuatis; apicibus incrassatis, oblique truncatis, et illic laterem dorsalem versus plus minus profunde excavatis; membrana glabra rubra vel rubiginosa; suturis medianis 1-6; cellulis granulis amylaceis magnis repletis, ita ut chromatophora et pyrenoides (in serie axiali?) obscurantur. Dist. inter apic., 195-210 μ ; lat. med., 24-25 μ .

Samples 158 (common), 159 (rare).

The individuals of this species, named after the collector, usually occurred in more or less extensive groups comprising any number of cells up to 50, arranged approximately parallel to one another and in close juxtaposition. The general shape of the cell (Fig. 6, *B*) is not unlike that of *C. leibleinii*, Kuetz., but the ends are altogether different, being obliquely truncated, more or less markedly thickened, and provided with a characteristic excavation of the membrane of varying depth (Fig. 6, *a, b*). The cell-wall, although apparently colourless when first secreted, very soon takes on a reddish or brownish-red tinge; in a few cases it showed a very fine granulation. The cells are provided with a varying number of median sutures (Fig. 6, *B*). The contents invariably included a large number of big starch grains, which made it impossible to decipher the chloroplast; a single axial series of pyrenoids, however, seems to be present.

There is some resemblance between this species and *C. excavatum*, Borge ("Suesswasseralg. aus Suedpatagonien," 'Bih. K. Sv. Vet.-Akad. Handl.', xxvii, Afd. III, No. 10, 1901, p. 19, Tab. II, figs. 7-9); in the latter, however, the ends are different, the membrane is apparently colourless, and there are no median sutures.

2. *Closterium parvulum*, Naegeli, Gatt. einzell. Algen., 1849, p. 106, Tab. VI, C, fig. 2; W. & G. S. West, *loc. cit.*, p. 133, Pl. XV, figs. 9-12.

Samples 36, 338, 339, 340.

Dist. inter apic., 112-135 μ ; lat., 11-13 μ .

Previously recorded from Cape Colony (Fritsch).

var. *angustum*, W. & G. S. West, *loc. cit.*, p. 134, Pl. XV, figs. 13, 14.

Samples 338, 339, 340.

Dist. inter apic., 93-96 μ ; lat., 6 μ .

3. *Closterium leibleinii*, Kuetz.; W. & G. S. West, *loc. cit.*, p. 141, Pl. XVI, figs. 9-14.

Sample 315.

Long., 208 μ ; lat., 35 μ .

Previously recorded from Little Namaqualand (G. S. West), from Madagascar (Fritsch), and Cape Colony and Orange Free State (Fritsch).

4. *Closterium moniliferum* (Bory, Ehrenb.; W. & G. S. West, *loc. cit.*, p. 142, Pl. XVI, figs. 15, 16.

Samples 26, 35, 64, 65, 85, 312, 327, 334, 336, 337.

Previously recorded from Little Namaqualand (G. S. West) and Cape Colony (Fritsch).

5. *Closterium ehrenbergii*, Menegh.; W. & G. S. West, *loc. cit.*, p. 143, Pl. XVII, figs. 1-4.

Samples 17, 18, 23, 329 (?), 334.

Previously recorded from Little Namaqualand (G. S. West).

Var. *concauum*, Schmidle, Suesswasseralg., in F. Reinecke, Flora d. Samoa-Inseln, Engler's Bot. Jahrb., xxiii, 1897, p. 256.

Forma major, margine ventrali in media parte cellulae fere recta. Long. cell., 520–570 μ ; lat., 90–102 μ (Fig. 6, A).

Sample 327.

6. *Closterium acerosum* (Schrank), Ehrenb.; W. & G. S. West, *loc. cit.*, p. 146, Pl. XVIII, figs. 2–5.

Samples 22, 23, 334.

Long., 330–405 μ ; lat., 34–40 μ .

Previously recorded from South Africa (G. S. West & Fritsch).

7. *Closterium lanceolatum*, Kuetz.; W. & G. S. West, *loc. cit.*, p. 149, Pl. XVII, figs. 9, 10, Pl. XVIII, fig. 7.

Samples 17, 23, 334, 336.

Long. cell., 387–405 μ ; lat., 57–66 μ .

Recorded from Madagascar (Fritsch), the Karoo and Little Namaqualand (G. S. West).

8. *Closterium pritchardianum*, Arch.; W. & G. S. West, *loc. cit.*, p. 172, Pl. XXII, figs. 6–14.

Forma ad var. *alpinum*, Schmidle (Oesterr. Bot. Zeitschr., xlv, 1895, p. 309, Pl. XIV, fig. 19) valde accedens, sed saepe longior et latior, membrana paene achroa et subtilissime striata, apicibus plerumque magis recurvis quam in specimine a Schmidle depicto. Dimens., 360 $\times$ 45, 420 $\times$ 54, 555 $\times$ 40, 660 $\times$ 45 μ .

Samples 85, 346 (very rare in the latter).

This form has to some extent the subparallel margins of var. *madagascariense*, Fritsch. The work already done on the freshwater Algae of South Africa shows that *C. pritchardianum* is very widely distributed and exhibits very considerable variability (*cf.* Fritsch, 1918, p. 547). It is hoped at a later date, when more data have been collected, to give an epitome of the different forms.

9. *Closterium pseudolibellula*, F. E. Fritsch, n. sp. (Fig. 7).

C. magnum; cellulis aut fusiformibus margine ventrali minus convexa quam margine dorsali (forma *fusiformis*) aut saepe margine dorsali valde convexa margine ventrali deplanata vel (raro) exigue concava (forma *genuina*), a media parte ad polos gradatim et magis attenuatis; polis truncatis et recurvis (qua nota in speciminibus biconvexis saepe indistincta val abest); membrana primum achroa, mox flavescens, in tota superficie punctis minutis numerosis irregulariter ordinatis oblecta; chromatophora e

ca. 10 laminis formata, pyrenoidibus magnis 3-5 in serie axiali in quaque semicellula. Dimens., 351×57 , 354×54 , 378×55 , 390×60 , 400×55 . 405×60 , $420 \times 57 \mu$; lat. apic., 6μ .

Sample 346 (common).

This rather distinct species occurs in two forms, the one (f. *fusiformis*) showing a marked superficial resemblance to *C. libellula*, Focke, the other (f. *genuina*) somewhat resembling a stout specimen of *C. pritchardianum* Arch.; the latter form is the more common.

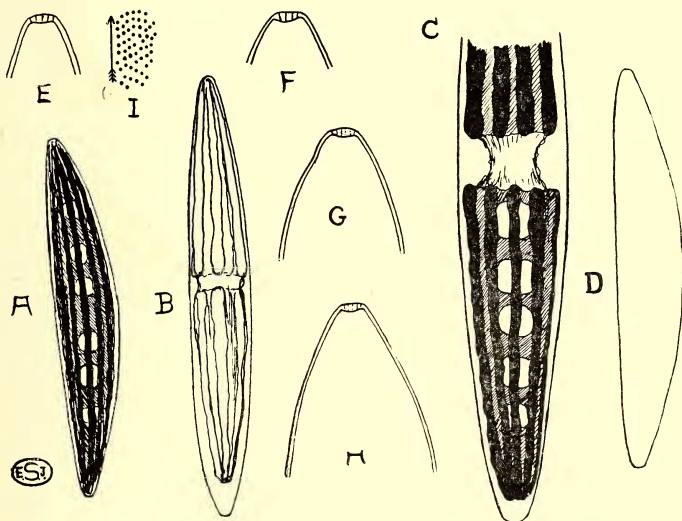


FIG. 7.—*Closterium pseudolibellula*, F. E. Fritsch, n. sp. A and D, f. *genuina*. B and C, f. *fusiformis*. E, F, G and H, apices of different specimens. I, disposition of the punctae on the membrane. A, B and D $\times 200$; C $\times 320$; remaining figures $\times 800$.

In f. *genuina* the ventral surface is either quite flat or very slightly convex; in rare cases it is very faintly concave. The ends are truncate (Fig. 7, F, H), or sometimes in young specimens rounded-truncate (Fig. 7, E, G); they are markedly recurved (Fig. 7, D), so that their appearance is very similar to that of the ends in *C. pritchardianum*. In f. *fusiformis* the recurved character is only very faintly indicated as a general rule (Fig. 7, B and G)—in fact in some individuals it is altogether indiscernible. A marked characteristic of the species lies in the fact that the membrane very soon takes on a yellowish or yellowish-brown tinge, and that the entire

surface bears a punctation which appears to be due to very numerous minute pits in the wall (*cf.* Fig. 7, *E-H*): The pits are quite irregularly arranged over all parts of the cell. The colouration of the membrane is in general rather faint. The protoplasmic contents were often highly vacuolate.

In shape *f. genuina* is not unlike some forms of *C. spetsbergense*, Borge ('Vid.-selsk. Skrift., Kristiania, I, Mat.-nat. Kl.,' 1911, No. 11, p. 8, fig. 5 *a*); this species is, however, considerably smaller and has a colourless glabrous membrane. Comparison may also be made with *C. massarti*, De Wildeman, *C. fusiforme*, Gay, and *C. methueni*, Fritsch.

10. *Closterium rostratum*, Ehrenb., W. & G. S. West, *loc. cit.*, p. 188, Pl. XXVI, figs. 1-5.

Samples 338 and 339 (in both cases with zygospores), 340.

Recorded from Madagascar (Fritsch).

GENUS PLEUROTOENIUM NÆGELI.

1. *Pleurotaenium ehrenbergii* (Bréb.), De Bary, Unters. ueb. d. Fam. d. Conjug., 1858, p. 75; W. & G. S. West, *loc. cit.*, p. 205, Pl. XXIX, figs. 9-11.

Samples 26, 327 (in the latter not uncommon).

Previously recorded from the Cape (Nordstedt and Fritsch).

2. *Pleurotaenium ovatum*, Nordstedt, Alg. aq. dulc. Brasil., Oefvers. K. Sv. Vet.-Akad. Foerhandl., 1877, No. 3, p. 18. (Syn.: *Docidium ovatum*, Nordst., Vid. Med. Nat. Foren. Kjobenhavn, 1869, p. 205, Tab. III, fig. 37.)

Sample 327.

Long. cell., 270-340 μ ; lat. max., 81-87 μ ; lat. constr., 45-60 μ ; lat. apic., 25-27 μ . These dimensions are appreciably less than those originally recorded by Nordstedt. Slightly smaller specimens have been described by Schmidle (Engler's 'Bot. Jahrb.', xxvi, 1899, p. 23) as var. *minor*, but it is doubtful if this variety can be retained, since the size of the species is subject to much fluctuation.

The specimens in sample 327, while showing the typical shape, exhibited the annular thickening at the constriction figured by W. & G. S. West for var. *tumidum*, Maskell ('Ann. Roy. Bot. Garden, Calcutta,' vi, Part II, 1907, Pl. XIII, fig. 8) and by Turner for his *Docidium rotundatum* ('Sv. Vet.-Akad. Handl.,' xxv, No. 5, 1892, t. vii, fig. 2 *a*), which is probably synonymous with the former. They also differed in the fact that the membrane appeared to be not punctate, but delicately and irregularly striate.

This species has been recorded from the Cape by Nordstedt and Fritsch.

GENUS EUASTRUM EHRENBERG.

1. *Euastrum submontanum*, F. E. Fritsch, n. sp. (Fig. 8).

E. parvum, circiter $1\frac{1}{2}$ plo longius quam latum, profunde constrictum sinu subangusto-lineari extus gradatim ampliato. Semicellulae obscure trilobae, sinu late aperto inter lobos; lobo polari lato, apice deplanato vel raro leniter convexo, incisura mediana subprofunda extus ampliata, cum granulis 2 in utroque latere incisurae, angulis apicalibus dente parvo munitis, marginibus lateralibus lobi polaris subparallelis; lobis lateralibus bilobulatis, iis superioribus rotundatis vel subtruncatis vel dente parvo munitis, iis inferioribus late rotundatis; semicellulis plerumque granulis ca. 4 intra lobum lateralem utrumque et granulis 5-6 intra angulum apicalem utrumque, membrana in media parte glabra. A latere visae elongato-ovatae

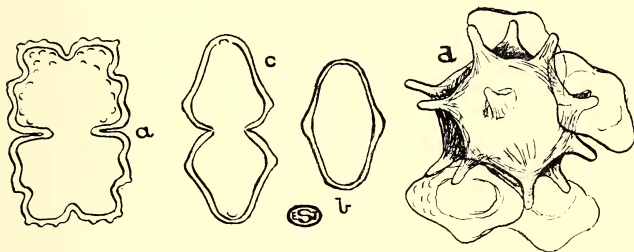


FIG. 8.—*Euastrum submontanum*, F. E. Fritsch, n. sp. *a*, front-, *c*, side-, and *b*, end-views. *d*, zygospore with the four semi-cells of the two conjugating individuals. $\times 1000$.

apice rotundato dente parvo munito, tumore distincto prope basin utrobique. A vertice visae ellipticae, polis rotundatis, inflatione mediana (ubi membrana incrassata) distincta. Zygosporis globosis processibus crassis basi auctis ca. 15 munitis.

Long. cell., 29-31 μ ; lat. cell., 19-22 μ ; lat. lob. pol., 15-17 μ ; lat. isthm., 6-7 μ ; crass., 14-16 μ ; lat. zygosp. sine proc., 20-21 μ ; long. proc. zygosp., 5-7 μ .

Sample 36 (rather rare).

This species shows considerable resemblance to *E. montanum*, W. & G. S. West, especially as regards the side- and end-views. The front-view is, however, rather different. The zygospore of *E. montanum*, which has been figured by Luetkemüller ("Desm. Boehmens," 'Verh. k. k. zool.-bot. Ges. Wien,' 1910, p. 483, fig. 2), also differs from that of *E. submontanum*, having more numerous and falcate processes.

2. *Euastrum simpliciforme*, F. E. Fritsch, n. sp. (Fig. 9).

E. subparvum, circiter 2plo longius quam latum, subprofunde constrictum sinu subangusto-lineari extus paullo ampliato. Semicellulae trapeziformes, apice leniter concavo vel interdum triundulato, lateribus leniter convergentibus tricrenatis (angulis apicalibus inclusis), crenis superioribus prope apice, crenis inferioribus ca. in media parte marginis lateralis; angulis basalibus subrectangulari-rotundatis. Membrana in tota superficie semicellulae glabra. A latere visae ellipticae, apice subrotundato, intra marginem lateralem lineis duabus cum crenis lateralibus

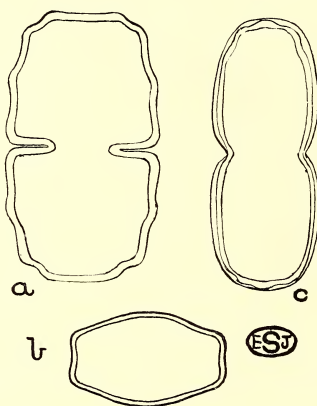


FIG. 9.—*Euastrum simpliciforme*, F. E. Fritsch, n. sp. a, front-, b, end-, and c, side-views. $\times 1100$.

in aspectu frontale congruentibus. A vertice visae subellipticae, polis deplanatis retusis, inflatione mediana subdistincta.

Long. cell., 40–42 μ ; lat. cell., 21–24 μ ; lat. isthm., 9 μ ; crass., 15–16 μ . Sample 327 (very rare).

This species might almost equally well be regarded as belonging to the genus *Cosmarium*, the chief reasons for referring it to *Euastrum* lying in the character of the side-view and the usual concavity of the apex of the semi-cell. As a matter of fact it shows considerable resemblance to *Cosmarium angulatum*, Perty, a species which is not at all well known. It differs from the latter in having a narrower isthmus and in the character of the lateral margins; the end-view, which is not known in the case of *Cosmarium angulatum*, also appears distinctive.

GENUS COSMARIUM CORDA.

1. *Cosmarium pachydermum*, Lundell, Desm. Suec., 1871, p. 39, Tab. II, fig. 15; W. & G. S. West, *op. cit.*, II, 1905, p. 139, Pl. LVII, fig. 7.

var. *tuberculatum*, F. E. Fritsch, nov. var. (Fig. 10).

Cellulis ca. $1\frac{1}{2}$ plo longioribus quam latis, a latere visis lateribus minus convexis apicibus minus rotundatis et cum membrana incrassata; semicellulis cum tuberculo late rotundato infra apicem utrobique e excavatione vadosa orto.

Long. cell., 70–90 μ ; lat. cell., 48–58 μ ; lat. isthm., 18–26 μ ; crass., 30–36 μ .

Sample 327 (very rare).

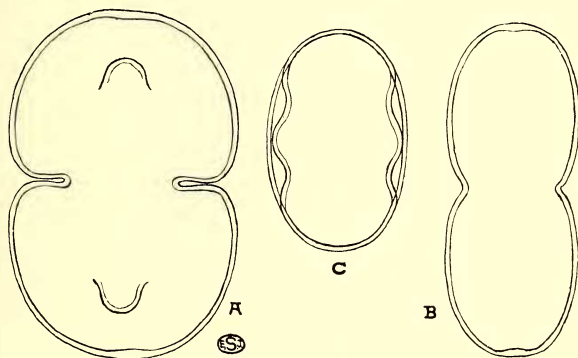


FIG. 10.—*Cosmarium pachydermum*, Lund., var. *tuberculatum*, F. E. Fritsch, nov. var. A, front-, B, side-, and C, end-views. $\times 660$.

This variety differs from the type in three respects, viz. the relation between length and breadth of the cell (the semicells being more circular than elliptical), the shape of the semicells in side-view, and the broad, rounded tubercle occurring a little way beneath the apex in the median line of each semicell (Fig. 10, A). This tubercle arises from the base of a shallow depression,—a fact which is particularly obvious in the end-view (Fig. 10, C); in the front-view it only becomes distinctly visible on focussing down to about one-quarter of the thickness of the semicell. This variety, in the possession of this feature, appears to bear much the same relation to *C. pachydermum*, Lund., that *C. aitchisonii*, Schaarschmidt ("Afghanistan Algae," 'Journ. Linn. Soc., Bot.,' xxi, 1884–5, p. 246, Pl. V, fig. 20) does to *C. nitidulum*, De Not. The end- and side-views of *C. aitchisonii*, Schaarschmidt, are, however, not known, but should they

prove to resemble those of *C. nitidulum*, De Not., the former species would be better regarded as a variety of the latter.

The membrane of var. *tuberculatum* often showed a minute granulation, but its presence was not always determinable.

2. *Cosmarium undulatum*, Corda; W. & G. S. West, *loc. cit.*, p. 148, Pl. LIX, figs. 1-3, 5.

var. *crenulatum* (Naeg.), Wittr.; W. & G. West, *loc. cit.*, p. 150, Pl. LIX, figs. 11, 12. (Syn.: *Euastrum crenulatum*, Naegeli, Gatt. einzell. Alg., 1849, p. 120, Tab. VII, A, fig. 7.) (Fig. nostr. 11, A.)

Sample 327 (rare).

Long. cell., 21-22 μ ; lat. cell., 16-17 μ ; lat. isthm. 6 μ . The dimensions are rather less than those given in Messrs. West's monograph, but Nordstedt ('Oefvers. K. Vet.-Akad. Foerhandl.,' Stockholm, 1872, No. 6, p. 32) has already recorded specimens of this variety measuring 24 μ in length and 20 μ in breadth.

3. *Cosmarium hammeri*, Reinsch; W. & G. S. West, *loc. cit.*, p. 181, Pl. LXII, figs. 20, 21.

Sample 86 (rare).

Long. cell., 45 μ ; lat. cell., 33 μ ; lat. isthm., 12 μ .

var. *africanum*, F. E. Fritsch, nov. var. (Fig. 11, B).

C. $1\frac{1}{2}$ - $1\frac{3}{4}$ plo longius quam latum; semicellulae apicibus truncatis vel leniter convexis (interdum obliquis), marginibus lateralibus superioribus late concavis, marginibus lateralibus inferioribus convexo-rotundatis vel raro subangularibus, interdum subrectis; a vertice visae ellipticae, polis rotundatis, inflatione mediana distincta; a latere visae subcirculares vel elliptico-circulares. Membrana indistincte granulata.

	μ	μ	μ	μ	μ	μ
Long. cell.	27	27	27	28	30	30
Lat. cell.	21	23	24	24	24	25
Lat. isthm.,	6-8 μ .	Lat. apic.,	10-11 μ .	Crass.,	15 μ .	

Sample 86 (very rare), 327 (not uncommon).

This variety appears to be rather widely distributed in South Africa, as it has also been observed in samples from other parts. The reference to *C. hammeri*, Reinsch, seems correct, since in front-view there is much resemblance to var. *homalodermum* (Nordst.), W. & G. S. West, which is much bigger, and var. *protuberans*, W. & G. S. West, in which, however, to judge by the figures given by Messrs. West, the upper part of the lateral margins is not nearly so markedly concave. The new variety, however, differs from both of those just mentioned in the fact that the apex is truncate (Fig. 11, B, a', a'') or even slightly convex (Fig. 11, B, a), and only very exceptionally faintly retuse; obliquity of the apex is not uncommon (Fig. 11, B, a), and, when pronounced, has a curious effect on the side-view, which then appears to bear an apical papilla. The granulation

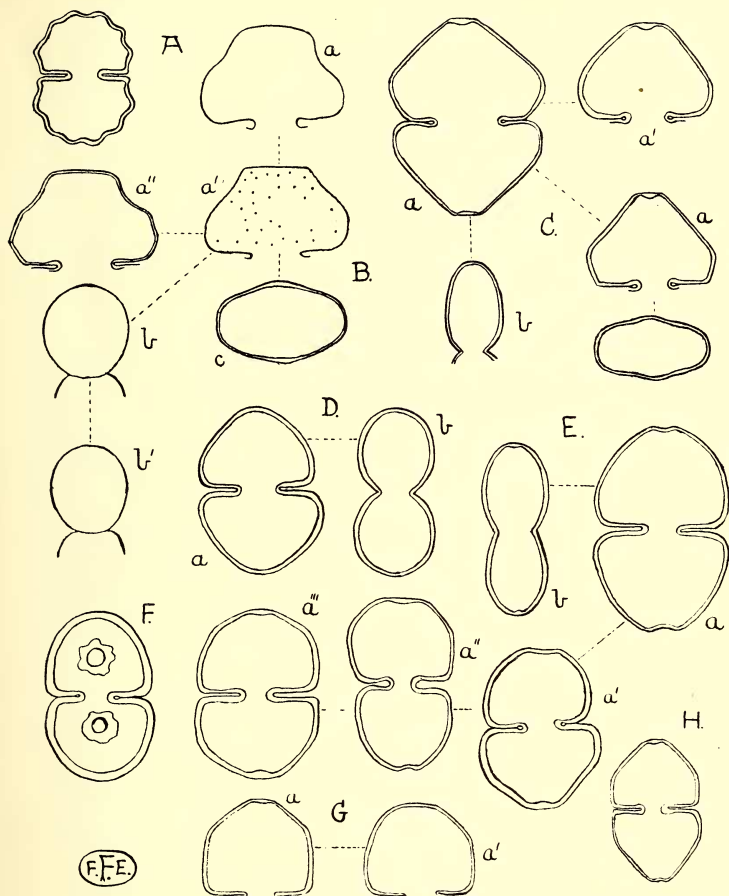


FIG. 11.—A, *Cosmarium undulatum*, Corda, var. *crenulatum* (Naeg.), Witttr. B, *C. hammeri*, Reinsch, var. *africanum*, F. E. Fritsch, nov. var. C, *C. granatum*, Bréb., var. *africanum*, F. E. Fritsch, nov. var. D, *C. laeve*, Rabenh., f. *acuminata*, n. f. E, *C. laeve*, Rabenh., the typical and various transitional forms. F, *C. laeve*, Rabenh., f. *rotundata*, n. f. G, *C. rectangulare*, Grun., forma. H, *C. granatum*, Bréb., forma. a, a', a'', front-views; b, b', side-views; c, end-view. All figures $\times 950$.

of the membrane is also unusual. The median inflation in end-view (Fig. 11, *B*, *c*) is not as pronounced as is usual in the varieties of this species, and in this respect var. *africana* forms a transition to the type, which is altogether without a median inflation. The somewhat variable side-view (Fig. 11, *B*, *b*, *b'*) is also different.

It is possible that the f. *acuta* described by Turner ('K. Sv. Vet.-Akad. Hand.,' xxv, 1892, p. 53, Tab. VIII, fig. 15) belongs to this variety. A closely allied species appears to be *C. aequale*, Turner (*loc. cit.*, p. 64, Tab. IX, fig. 31).

4. *Cosmarium granatum*, Bréb.; W. & G. S. West, *loc. cit.*, p. 186, Pl. LXIII, figs. 1-3.

Samples 26, 158.

Previously recorded from Cape Colony (Fritsch).

Long. cell., 24-45 μ ; lat. cell., 19-35 μ ; lat. isthm., 6-8 μ .

forma apicibus leviter incrassatis vel etiam retusis.

Long. cell., 24 μ ; lat. cell., 18 μ ; lat. isthm., 6 μ (Fig. 11, *H*).

Sample 327 (rare).

Some specimens of this form had semicells in which the angles were more rounded than in Fig. 11, *H*, such individuals grading over into the forms of *C. laeve*, Rabenh., mentioned below.

Var. *africanum*, F. E. Fritsch, nov. var. (Fig. 11, *C*).

Semicellulis lateribus prope basin divergentibus, lateribus superioribus rectis vel levissime concavis, apicibus angustis truncatis, saepe cum membrana paullo incrassata; a latere visis lateribus minus convexis quam in typo, apicibus late rotundatis; a vertice visis ellipticis inflatione mediana distincta. Long. cell., 30-38 μ ; lat. cell., 21-24 μ ; lat. apic., 4-5 μ ; lat. isthm., 5-10 μ ; crass., 10-15 μ .

Sample 327 (rather rare).

This variety (*cf.* especially fig. 11, *C*, *a''*) seems to be near var. *subangulare*, W. & G. S. West ("Alg. Madagascar," 'Trans. Linn. Soc., Bot.,' v, 1895, p. 54, Pl. VIII, fig. 4), but the latter has retuse upper lateral margins, a retuse and rather wider apex, and a much narrower isthmus. The end-view is also quite different. There is considerable resemblance to *C. pseudogranatum*, Nordst., *forma*, Gutwinski ('Rozprawy Akad. Umiej. Wyd. Mat.-Przyz. Krakow,' ser. 2, xiii, 1898, p. 44, Tab. VII, fig. 38).

5. *Cosmarium pseudonitidulum*, Nordst.; W. & G. S. West, *loc. cit.*, p. 195, Pl. LXIII, fig. 26.

Var. *validum*, W. & G. S. West, *loc. cit.*, p. 196, Pl. LXIII, figs. 27-30. (Syn.: *C. pachydermum*, Lund., var. *minus*, Nordst.)

Samples 311, 312.

Long. cell., 70-72 μ ; lat. cell., 55-58 μ ; lat. isthm., 18-21 μ . Cell-wall thick and densely punctate.

6. *Cosmarium capense*, De Toni, Sylloge Algarum, etc., i, 1899, p. 969, (Syn.: *C. pyramidatum*, Bréb., subsp. *capense*, Nordstedt, De Alg. nonnull. praeipue Desm., etc., Act. Univ. Lund, xvi, 1880, p. 6, Tab. I, fig. 8.)

Samples 86, 158, 327.

Long. cell., 90–117 μ ; lat. cell., 69–84 μ ; lat. isthm., 20–24 μ ; crass., 60 μ . In all cases the specimens were quite typical, the basal angles in front view being broadly rounded, the end-view broadly elliptical, and the membrane strongly punctate. This species has been recorded from the Cape by Nordstedt and Fritsch.

7. *Cosmarium obtusatum*, Schmidle, Engler's Bot. Jahrb., xxvi, 1898, p. 38; W. & G. S. West, *op. cit.*, iii, 1908, p. 7, Pl. LXXV, figs. 13, 14.

Samples 311, 312 (not uncommon).

Long. cell., 60–64 μ ; lat. cell., 54–57 μ ; lat. isthm., 15–16 μ ; crass., 21–24 μ . This species has been recorded by Schmidle from East Africa, by G. S. West from the Karoo, and by Fritsch from the Orange Free State.

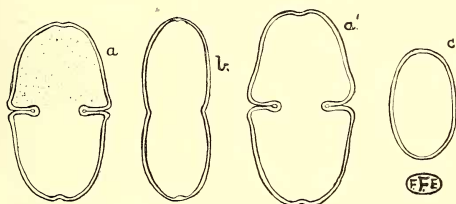


FIG. 12.—*Cosmarium quadratum*, Ralfs, var. *africanum*, F. E. Fritsch, nov. var. a, a', front-, b, side-, and c, end-views. $\times 750$.

8. *Cosmarium quadratum*, Ralfs; W. & G. S. West, *loc. cit.*, p. 57, Pl. LXX, figs. 6–8.

Var. *africanum*, F. E. Fritsch, nov. var. ("forma apice leviter retuso, membrana levissime punctata," Fritsch, Alg. Cape Peninsula, Ann. S. Afr. Mus., ix, 1918, pp. 552, 553) (Fig. 12).

Semicellulis apice leviter retusis, angulis basalibus evidenter productis lateribus convexis vel leniter concavis; a latere visis in apicem paullo incrassatis. Membrana levissime punctata. Long. cell., 39–49 μ ; lat. cell., 21–25 μ ; lat. isthm., 11–12 μ ; crass. 14–15 μ .

Sample 36 (rather rare).

The outstanding feature of this variety is the retuse character of the apex, which is to be observed in all cases, though varying somewhat in depth. In side-view (Fig. 12, b) the membrane at the apex of the semicell invariably appears thickened. The punctation of the membrane is rather faint.

9. *Cosmarium regnellii*, Wille, Sydamerik. Algfl., etc., Bih. K. Sv. Vet.-

Akad. Handl., viii, No. 18, 1884, p. 16, Tab. I, fig. 34; W. & G. S. West, *loc. cit.*, p. 89, Pl. LXXII, fig. 25-28.

Forma angulis lateralibus ca. in media longitudinis semicellulae, marginibus omnibus plus minus retusis, apice lata et exigue retusa. Long. cell., $15\ \mu$; lat. cell., $12\ \mu$; lat. isthm., $3\ \mu$; crass., $7\ \mu$. (Fig. 13.)

Sample 327 (very rare).

In front-view this is very much like var. *minimum*, Eichler and Gutwinski ('Rozprawy Akad. Umiej. Wyd. Mat.-Przyr. Krakow,' ser. 2, viii, 1895, p. 164, Tab. IV, fig. 6), but this variety is described as having an end-view with a slight median inflation. There is also some resemblance with f. *minor*, Boldt, and with f. *minima* of *C. sexangulare*, Lund.; in the latter, however, the lower parts of the lateral margins are not retuse. It is to be noted that these margins differed somewhat in the specimens examined,

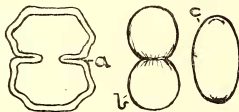


FIG. 13.—*Cosmarium regnellii*, Wille, forma. a, front-, b, side-, and c, end-views. $\times 1100$.

especially as regards their degree of divergence; in some cases they were almost subparallel, and as a consequence the degree of projection of the lateral angles also varied considerably.

10. *Cosmarium meneghinii*, Bréb.; W. & G. S. West, *loc. cit.*, p. 90, Pl. LXXII, figs. 29-32.

Sample 341 (very rare).

Forma africana, n. f. (*forma* "marginibus lateralibus inferioribus leviter divergentibus; alioqui typo et non var. *nano*, Wille similis est," Fritsch, *loc. cit.*, p. 555). Long. cell., $18-24\ \mu$; lat. cell., $12-15\ \mu$; lat. isthm., $5\ \mu$.

Samples 64, 312 (in both cases rare).

11. *Cosmarium rectangulare*, Grun.; W. & G. S. West, *loc. cit.*, p. 54, Pl. LXX, figs. 1, 2.

Forma ad var. *africanum*, W. & S. G. West ("Alg. Centr. Afr.," Journ. Bot., xxxiv, 1896, p. 379, Tab. 361, fig. 14) accedens, sed apicibus angustioribus (et raro leviter retusis), semicellulis a vertice visis ellipticis. Long. cell., $24-33\ \mu$; lat. cell., $18-20\ \mu$; lat. isthm., $5-6\ \mu$. (Fig. 11, G.)

Sample 327 (rather rare).

These specimens approach closely to some of the forms of *C. laeve*, Rabenh., to be described below, and it is possible that they would best be regarded as extreme variations of this species. As shown in Fig. 11, G,

a and *a'*, the shape is somewhat variable, the angles tending to round off in some specimens. In some cases there was a slight thickening of the membrane at the apex, and as a rare feature the latter appeared very faintly retuse. The membrane was mostly, but seemingly not always, punctate. The specimens differ both from the type and from var. *africanum*, W. & G. S. West, in the very narrow apex, but even in this respect there was a certain amount of variation.

The form here described is somewhat similar to that recorded from the Cape Peninsula (Fritsch, *loc. cit.*, p. 555, fig. 28, *c*), but has, on the whole, a narrower apex. It also shows some resemblance to forms of *C. granatum*, Bréb., described by Borge ("Subfoss. soetvattensalg. fran Gotland," Bot. Notiser, 1892, p. 56, and especially fig. 6).

12. *Cosmarium laeve*, Rabenhorst, Fl. Europ. Alg., iii, 1868, p. 161; W. & G. S. West, *loc. cit.*, p. 99, Pl. LXXIII, figs. 8-19.

Forma *typica*. Long. cell., 22-36 μ ; lat. cell., 16-24 μ ; lat. isthm., 4.5-6 μ ; crass., 12 μ ; lat. zygosp., 16 μ . Membrana saepe laevis. (Fig. 11, *E*, *a*, *b*.)

Samples 86, 327 (with zygospores), 345.

Previously recorded from Little Namaqualand (G. S. West).

Forma *minor* ad var. *octangularem* (Wille), W. & G. S. West accedens. Long. cell., 16 μ ; lat. cell., 15 μ ; lat. isthm., 3 μ .

Sample 158 (very rare).

Forma *rotundata*. Apicibus non retusis. Long. cell., 30-31 μ ; lat. cell., 18-19 μ ; lat. isthm., 5-6 μ . (Fig. 11, *F*.)

Sample 327 (rather rare).

Forma *acuminata*. Lateribus valde convergentibus, apicibus subrotundatis non retusis; semicellulis a latere visis lateribus plus rotundatis. Long. cell., 30 μ ; lat. cell., 22 μ ; lat. isthm., 6 μ ; crass., 14 μ . (Fig. 11, *D*.)

Sample 327 (rare).

It is manifest that *C. laeve* is very variable in South Africa, since other forms have already been recorded from the Cape (Fritsch, 1918, p. 555). The specimens illustrated in Fig. 11, *D*, *E*, and *F*, were all drawn from the material in sample 327, but they only represent the outstanding forms, and numberless transitions between them were encountered. The typical form (Fig. 11, *E*, *a*) has retuse apices and smooth, rounded sides, the membrane in the present material being never more than obscurely punctate and in many cases seemingly quite smooth (*cf.* Fritsch, *loc. cit.*, p. 555). According to Messrs. West's monograph, "the slight retuseness in the middle of the apex is characteristic of all forms of the species," but it appears doubtful whether this statement really applies. Messrs. West ("Freshwater Chlorophyc., in J. Schmidt, 'Fl. Koh Chang, Bot. Tidsskrift,' xxiv, 1901, Tab. II, fig. 14)

have themselves figured specimens in which the retuse apex is scarcely recognisable (*cf.* also Raciborski, 'Rozprawy Akad. Umiej. Krakow,' ser. 2. ii, 1892, Pl. VI, fig. 20, *a*), and in sample 327 forms were encountered (*f. rotundata*, Fig. 11, *F*) in which the apices were smoothly rounded off and without any trace of retuseness (side-view as in Fig. 11, *E*; *b*). Such specimens might be regarded as not belonging to *C. laeve*, were it not that they are connected with the typical form by transitions; thus, individuals were occasionally met with in which one semicell showed a retuse apex, whilst the other was rounded off as in Fig. 11, *F*. Numerous specimens were, moreover, observed in which the apex was retuse on the one semicell but merely slightly thickened on the other (Fig. 11, *E*, *a'*, *a''*). A reference to Figs. 11, *E*, *a*, *a'*, *a''*, *a'''* further shows that the shape of the semicells (either of one or both) is subject to considerable variation. Thus, the lower parts of the sides may be almost subparallel (Fig. 11, *E*, *a'*, especially the lower semicell), the sides may be somewhat angular (as in Fig. 11, *E*, *a''*), and the width of the apex rather diverse (*cf.* Fig. 11, *E*, *a*, *a'*, *a''*, etc.).

Specimens like those figured in Fig. 11, *E*, *a''*, lead over to the form of *C. rectangulare*, Grun., shown in Fig. 11, *G* (especially *a'*), whilst forms like those represented by the lower semicell in Fig. 11, *E*, *a'*, are transitional to forms of *C. granatum*, Bréb. (*cf.* Fig. 11, *H*, and p. 32).

In some few cases individuals were observed in which the sides of the semicells converged very markedly (*f. acuminata*, Fig. 11, *D*); in these the apex was not retuse, but more or less rounded, and the semicells, in side-view (Fig. 11, *D*, *b*), were more rounded than was the case with the other forms (*cf.* Fig. 11, *E*, *b*).

It would thus appear that *C. laeve*, Rabenh., may vary in respect of the apex, the punctuation of the membrane, and the form of the lateral margins, extreme conditions approaching on the one hand to *C. granatum*, Bréb., on the other hand to *C. rectangulare*, Grun.

13. *Cosmarium sportella*, Bréb.; W. & G. S. West, *loc. cit.*, p. 185, Pl. LXXXII, figs. 12, 13.

var. *simplex*, F. E. Fritsch, nov. var. (Fig. 14).

Cellulis a fronte visis apice laevi, lenissime convexo vel truncato vel lenissime retuso; a vertice visis late ellipticis, inflatione mediana nulla; membrana cum granulis sparsis non punctulata, sine tumore centrali. Long. cell., 48–50 μ ; lat. cell., 39–42 μ ; lat. isthm., 10–12 μ ; crass., 24–26 μ .

Samples 312, 314, 315.

This variety, apart from the slightly larger dimensions, differs from the type mainly in the absence of the central granulated tumour in front- and end-views. Since this tumour is developed to a very variable extent in the type itself, it is possible that no sharp limit could be drawn between it and the new variety.

14. *Cosmarium punctulatum*, Bréb.; W. & G. S. West, *loc. cit.*,^s p. 206, Pl. LXXXIV, figs. 13, 14.

Sample 86 (very rare).

A small form. Long. cell., $27\ \mu$; lat. cell., $24\ \mu$; lat. isthm., $8\ \mu$. Previously recorded from the Cape (Reinsch, Fritsch) and Orange Free State (Fritsch).

15. *Cosmarium subcrenatum*, Hantzsch; W. & G. S. West, *loc. cit.*, p. 228, Pl. LXXXVI, figs. 10-14.

Samples 26 and 71.

Long. cell., $24-30\ \mu$; lat. cell., $18-25\ \mu$; lat. isthm., $7-10\ \mu$.

Previously recorded from the Cape and Orange Free State (Fritsch).

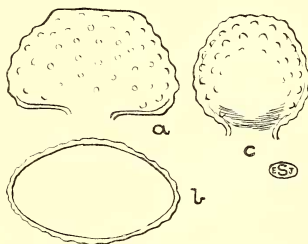


FIG. 14.—*Cosmarium sportella*, Bréb., var. *simplex*, F. E. Fritsch, nov. var. *a*, front-, *b*, end-, and *c*, side-views. $\times 750$.

16. *Cosmarium subprotumidum*, Nordst.; W. & G. S. West, *loc. cit.*, p. 231, Pl. LXXXVI, figs. 19-21 (fig. nostr. 16, *B*).

Sample 327 (very rare).

The typical form of this Desmid was very rare in the present material, and even the few specimens observed did not altogether agree with the description and figures in Messrs. West's monograph, the basal angles in front-view being less markedly rectangular, and the tumour, though well marked, not quite so prominent in the side- and end-views. The tumour bore three rows of granules, the middle one consisting of four, the side ones of three. The dimensions were: Long. cell., $27\ \mu$; lat. cell., $24\ \mu$; lat. isthm., $6\ \mu$; crass. $16\ \mu$ (Fig. 16, *B*).

It seems that this species is widely distributed in Africa and that it is subject to considerable variation. It has been recorded by Prof. West from Nyassa, Victoria Nyanza, and Tanganyika, the var. *gregorii* (Roy et Biss.), W. & G. S. West by Fritsch from the Cape and Orange Free State, whilst Schmidle has described a *Cosmarium occultum* from Lake Nyassa, which Messrs. West regard as a probable form of *C. subprotumidum*.

In sample 327 there occurred numerous *Cosmaria* diverging more or less markedly from *C. subprotumidum* proper, as described and figured for instance in Messrs. West's monograph. It has not proved possible to discriminate between these different *Cosmaria* and, although the extreme forms are sufficiently distinct from *C. subprotumidum*, they are connected with it by a whole series of transitional forms (Fig. 15). All of these forms agree to a more or less marked extent in certain respects which constitute points of difference from the typical *C. subprotumidum*. These common features are as follows.

Special granules are not developed in the central part of the semicell, although now and again slightly larger ones are found in this region. This feature is connected with a weaker differentiation of the central tumour—a fact which is very obvious in the side- and end-views (Fig. 15). In a few cases there appears to be a semicircular bare area between the marginal and central granules of the semicell, as seen in front view—an approximation to the condition found in the type—although the central granules are not larger than the others. As a rule, however, the entire semicell is uniformly granulated, the granules being arranged in more or less well-marked concentric series and often also in radiating series, although the arrangement is always more or less irregular in the centre of the semicell. In all the specimens, lastly, the apex appears smooth and truncate, an occasional appearance of undulation (as in Fig. 15, VI and VIII) being due to the presence of three to four granules just within the margin.

It may be noticed that W. West (Freshw. Alg. W. Ireland, Journ. Linn. Soc., Bot., xxix, 1891, p. 157, Pl. XXIV, fig. 21) has described a form of *C. subprotumidum* with more scattered granules and weakly differentiated central granules (*cf.* also Messrs. West's monograph, *loc. cit.*, p. 232, Pl. LXXXVI, fig. 22), and such a form helps to link up the specimens here described with the typical *C. subprotumidum*; it would be interesting to know the character of the side- and end-views of this form, since they would presumably show reduction of the central tumour. The form described by Schmidle as *C. occultum* would differ from all these in the fact that granules are altogether wanting in the middle of the semicells, and it is significant that Schmidle's rather poor figure (Engler's Bot. Jahrb., xxxii, 1902, Tab. I, fig. 25) shows a relatively slight tumour in end- and side-views.

The specimens in sample 327 that come nearest to *C. subprotumidum* are shown in Fig. 15, VIII, IX, and X (IX having the same sort of end- and side-views as VI). Such specimens are generally of rather small dimensions: long., 21–22 μ (rarely as much as 27 μ , or even 30 μ , the greatest length noted); lat., 18–19 μ (rarely up to 25 μ); lat. isthm., 5–6 μ ; crass., 14–15 μ . They agree more or less with the type in the shape of the semicells (especially Fig. 15, VIII and X), in the rectangular basal angles, and in the fact that

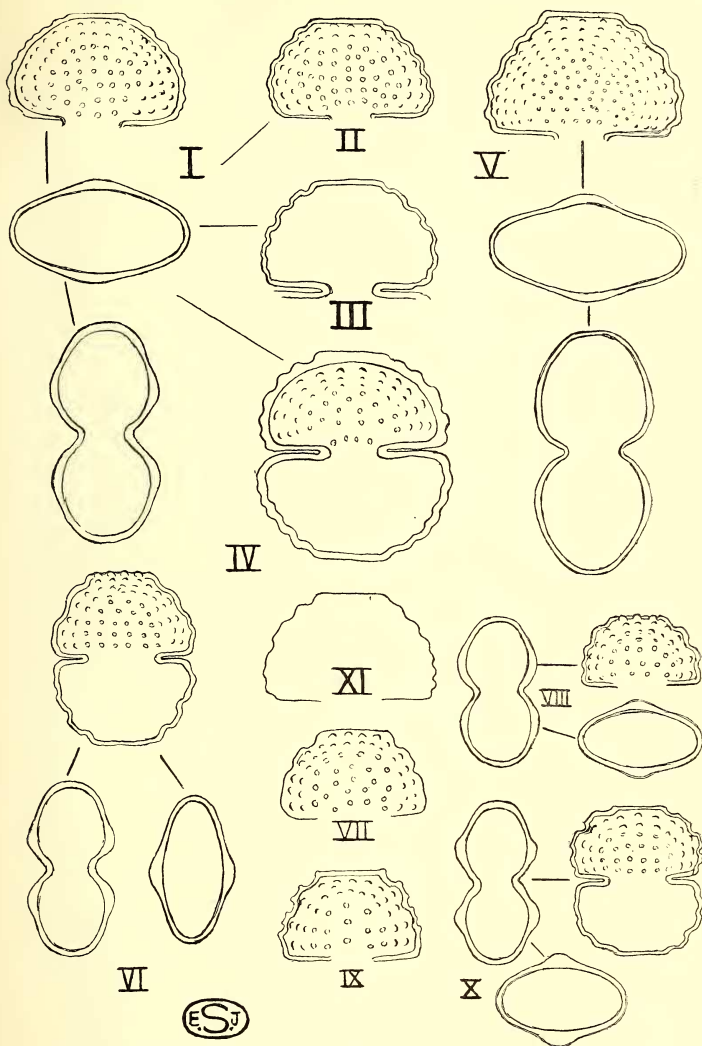


FIG. 15.—*Cosmarium subprotumidum*, Nordst., subsp. *simplex*, F. E. Fritsch, n. subsp. I, II, V, var. β . VIII-X, var. α . VI, VII, and XI, forms of var. β . III, IV, forms of var. α . $\times 1000$.

the upper converging parts of the sides are provided with two hollows with a median crest which is retuse or even emarginate, whilst the lower parts of the sides are variously crenated. VIII is perhaps the specimen which approximates most closely in these respects, whilst X is characterised by sides which are more markedly subparallel than is usually the case, hand in hand with which appears to go the development of the tumour nearer the middle of the semicell, as seen in side-view. IX approximates somewhat towards var. *gregorii* in the bigranulate character of the crenations.

Somewhat more divergent forms are shown in Fig. 15, VII and XI; these are characterised by a rather pronounced delimitation of the apex of the semicell as a kind of square-edged apical protuberance, due to the upper hollow being deeper than usual—a feature which is also indicated in IX. VII is further distinguished by the absence of crenations on the lower parts of the lateral margins; its dimensions were: long., 25–28 μ ; lat., 22 μ ; lat. isthm., 6 μ ; side- and end-views, as in VI. XI is characterised by a tendency towards equalisation of the crenations on the lower and upper parts of the sides (*cf.* especially the right-hand side of the semicell), although the upper ones are still larger than the lower ones.

These two specimens lead over on the one hand to that shown in Fig. 15, VI, on the other hand to those depicted in Fig. 15, I–V. The specimen VI resembles VII, except that the apex is not so sharply delimited. The median crest on the upper part of the lateral margins is still well marked though not always retuse, but the crenations on the lower parts of the sides are feeble. The dimensions were: long., 28–30 μ ; lat., 24 μ ; lat. isthm., 6 μ ; crass., 14–15 μ . Specimens of this kind were also seen with minute granules or teeth on the lateral crenations, similar to those in Fig. 15, IX.

The forms VI, VII, and XI differ from those in Fig. 15, VIII–X, in that they tend to show a gradual convergence of the lateral margins, beginning a little way above the base of the semicell. This feature is clearly indicated in IX.

The remaining forms (Fig. 15, I–V) show this convergence to a more marked extent, and this is accompanied by an increasing equalisation of the crenations on the lateral margins (*cf.* var. *simplicius*, Schmidle, Hedwigia, xxxiv, 1895, p. 77, Tab. I, fig. 10). Specimen III is most like *C. subprotumidum*, but has two crests instead of one on the upper parts of the lateral margins; in IV and V, whilst the upper crenations are still the larger, they are rounded like the lower ones and not retuse; in II the distinction between the lower and upper crenations is but feebly indicated, whilst the extreme condition is reached in specimen I, with a very regular convergence of the lateral margins and practically uniform crenation.

These individuals, with converging lateral margins and a tendency towards uniform crenation, are the largest of the series, although connected with the smaller ones by specimen VI. Their dimensions are: long.,

30–33 μ ; lat., 24–29 μ (usually 27–29 μ , only specimen II being as narrow as 24 μ); lat. isthm., 6–6.5 μ ; crass., 15–18 μ . The granules of these larger specimens are more numerous and apparently somewhat smaller than those of the others, whilst the central tumour is on the average less strongly developed—in fact, in some cases it is practically unrecognisable in side-view (Fig. 15, V).

It appears that two main types are concerned, viz. (a) a larger one (average length, 30–33 μ), with more or less convex lateral margins gradually converging from the base of the semicell to the apex, and rather numerous lateral crenations which are equal or subequal (Fig. 15, I, II, V), and (b) a smaller one (average length, 21–22 μ), with the lower parts of the lateral margins subparallel, and a pronounced larger, generally retuse, crest on the upper parts of the lateral margins (Fig. 15, VII–X). Transitions to

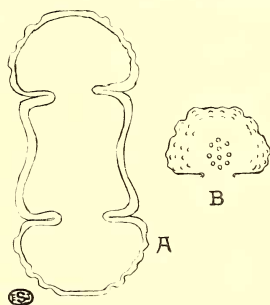


FIG. 16.—*Cosmarium subprotumidum*, Nordst. A. Abnormal specimen, similar to that shown in Fig. 15, II. B. Almost typical semicell. $\times 750$.

type (b) are afforded by specimens III and IV, whilst transitions to type (a) are seen in VI and XI. It must be realised that there is no question of any sharp demarcation, however; if occasion had offered for the presentation of still more numerous figures, a complete series of transitions could have been shown.

It would seem to be best to include all these specimens in a subspecies *simplex*, characterised by feeble development of the central tumour, which lacks all special granulation, by uniform and generally concentric granulation of the entire semicells, and by a smooth truncate apex. I would include in this subspecies the form described by W. West (*cf.* above), and also *C. occultum*, Schmidle. Brief diagnoses are given in the following:

Cosmarium subprotumidum, Nordst., subsp. *simplex*, F. E. Fritsch, nov. subsp.: Differt a typo tumore centrali parvo sine granulis majoribus vel distincte dispositis; granulis in tota superficie semicellularum aequalibus plerumque concentricis; apicibus semicellularum planis truncatis. Long.

cell., 21–33 μ ; lat. cell., 18–29 μ ; lat. isthm., 5–6.5 μ ; crass., 14–18 μ (Fig. 15).

var. *a*, forma minor angulis basalibus rectangularibus, marginibus lateralibus superioribus convergentibus crista mediana retusa vel etiam emarginata munitis, marginibus lateralibus inferioribus varie crenatis subparallelis. Long. cell., 21–22 μ (raro usque 27 μ , vel etiam 30 μ); lat. cell., 18–19 μ (raro usque 25 μ); lat. isthm., 5–6 μ ; crass., 14–15 μ . Hac varietas ad typum appropinquat (Fig. 15, VIII–X).

Formae apicibus plus minus distincte delimitatis, crenis in parte inferiore marginum lateralium parum efformatis (Fig. 15, VI, VII, XI). Pro parte ad var. *β* accedens.

Forma, W. West, Alg. W. Ireland, 1891 (*loc. cit.*).

var. *β* , forma major marginibus lateralibus plus minus convexis, a basi ad apicem gradatim convergentibus, crenis marginum lateralium frequentioribus aequalibus vel subaequalibus. Long. cell., 30–33 μ ; lat. cell., 27–29 μ (raro 24 μ); lat. isthm., 6–6.5 μ ; crass., 15–18 μ . Hac varietas a typo plus discedit (Fig. 15, I, II, V).

Forma marginibus lateralibus superioribus cristis retusis vel truncatis duabus (Fig. 15, III).

Forma crenis superioribus marginum lateralium majoribus (Fig. 15, IV).

Var. *occultum* (Schmidle), 1902 (*loc. cit.*), forma minor marginibus lateralibus convergentibus, apicibus paullo protrusis leniter undulatis; marginibus lateralibus superioribus crista mediana paullo emarginata munitis; in media semicellula granulis nullis. Long. cell., 22 μ ; lat. cell., 20 μ .

A curious abnormality observed among these forms of *C. subprotumidum* is shown in Fig. 16, A.

17. *Cosmarium calcareum*, Wittr.: W. & G. S. West, *loc. cit.*, p. 235, Pl. LXXXVII, figs. 1, 2.

Samples 311, 312, and 315.

Long. cell., 24 μ ; lat. cell., 18–20 μ ; lat. isthm., 6 μ .

18. *Cosmarium botrytis*, Menegh.; W. & G. S. West, *op. cit.*, iv, 1912, p. 1, Pl. XCVI, figs. 1, 2, 5–15.

Sample 159 (very rare).

Long. cell., 63–68 μ ; lat. cell., 57 μ ; lat. isthm., 18–21 μ .

Previously recorded from the Karoo (G. S. West), Cape Colony and Orange Free State (Fritsch).

Var. *pegleri*, F. E. Fritsch, nov. var. (Fig. 17).

Cellulis granulis majoribus frequentioribus, apicibus evidenter truncatis vel etiam retusis, a vertice visis polis subdeplanatis, a latere visis marginibus

lateralibus minus convexis. Long., 85-96 μ ; lat., 66-72 μ ; lat. isthm., 18-21 μ ; crass., 41-42 μ .

Sample 327 (rare).

This variety is distinguished by the possession of larger and more numerous granules, by the truncate or even retuse apex, by the flattening of the poles in end-view, and the shape of the semicell in side-view. It approaches somewhat to var. *emarginatum*, Hansgirg (Prodr. Algenfl

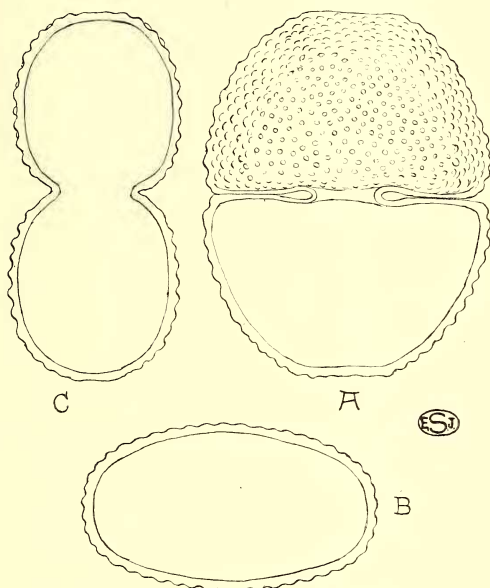


FIG. 17.—*Cosmarium botrytis*, Menegh., var. *pegleri*, F. E. Fritsch, nov. var. A, front-, B, end-, and C, side-views. $\times 660$.

Boehmen, i, 1888, p. 199, fig. 116), in which, however, the apex is much narrower. There is also some resemblance to *C. deltoideum*, Delp., although end- and side-views are markedly different.

19. *Cosmarium gayanum*, De Toni; W. & G. S. West, loc. cit., p. 7, Pl. CIII, figs. 5, 6.

Var. *rotundata*, F. E. Fritsch, nov. var. (Fig. 18).

Apicibus semicellularum in aspectu frontali rotundatis haud truncatis, granulis minus regulariter ordinatis, praecipue in media parte semicellularum.

Aspectus verticalis et lateralis typo similes sunt. Long. cell., 75–88 μ ; lat. cell., 48–58 μ ; lat. isthm., 16–18 μ ; crass. 35–36 μ .

Sample 327 (very rare).

This variety is characterised by the complete rounding off of the apices of the semicells and by the more irregular arrangement of the granules, especially in the centre of the semicell. It appears to bear the same relation to the type as var. *subrotundatum*, West, does to *C. conspersum*, Ralfs. Schmidle (Alg. Carolinen, Hedwigia, xl, 1901, p. 347, Tab. XII, fig. 5) has described a var. *major* of *C. margaritatum* (Lund.), Roy et Biss., which comes rather close to this variety of *C. gayanum*.

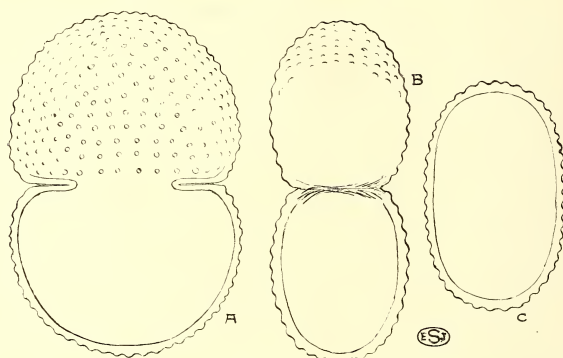


FIG. 18. — *Cosmarium gayanum*, De Toni, var. *rotundata*, F. E. Fritsch, nov. var. A, front-, B, side-, and C, end-views. $\times 660$.

20. *Cosmarium quadrum*, Lund. ; W. & G. S. West, *loc. cit.*, p. 20, Pl. C, figs. 3–6.

Forma paullo minor. isthmo valde incrassato, granulis saepe plus minus excavatis. Long. cell., 48–57 μ ; lat. cell., 44–52 μ ; lat. isthm., 15–18 μ (Fig. 19).

Samples 327, 331, and 336.

This form, as far as dimensions are concerned, comes between var. *minus*, Nordst., and the type, but it is especially distinguished by the strong thickening of the membrane at the inner edge of the isthmus, which is usually more or less triangular in shape; the thickening and longitudinal extension of this region was sometimes even more pronounced than in Fig. 19. An isthmus of a similar character is found in *C. orthopleurum*, Roy et Biss.

ourn. Bot., xv, 1886, p. 194, Tab. 269, fig. 16), which is probably but a variety of *C. quadrum*, in which, however, intergranular punctations are present. The granules in the present form were generally more or less hollow

(cf. var. *sublatum* (Nordst.), W. & G. S. West), although specimens were seen in which they were very nearly solid. In all other respects there was complete agreement with the type.

Var. *minus*, Nordstedt, Norges Desmid., Act. Univ. Lund, ix, 1873, No. 10, p. 11; W. & G. S. West, *loc. cit.*, p. 21.

Sample 86.

Long. cell., $48\ \mu$; lat. $45\ \mu$; lat. isthm., $12\ \mu$.

21. *Cosmarium pseudobroomei*, Wolle; W. & G. S. West, *loc. cit.*, p. 22, Pl. C, figs. 7, 8.

Var. *convexum*, W. & G. S. West, *loc. cit.*, p. 23, Pl. C, fig. 9.

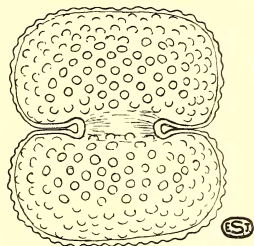


FIG. 19.—*Cosmarium quadrum*, Lund., forma. $\times 660$.

Sample 345.

Another form of this species has been recorded from Cape Colony (Fritsch), and the type from Madagascar (Fritsch).

GENUS STAURASTRUM MEYEN.

1. *Staurastrum striolatum* (Naeg.), Arch.; W. & G. S. West, *loc. cit.*, p. 177, Pl. CXXVII, figs. 1–5.

Sample 159 (very rare).

Previously recorded from the Cape (Fritsch).

(3) ZYGNEMACEAE.

GENUS SPIROGYRA LINK.

1. *Spirogyra decimina* (Muell.), Kuetzing, Phycol. germ., 1845, p. 223; Tabul. Phycol., v, 1855, Pl. XXIII, fig. 3, Pl. XXIV, fig. 1; Petit, *Spirogyra* d. env. d. Paris, 1880, p. 25, Pl. VIII, figs. 1–3; Borge, Zygnumales, in Suesswasserfl. Deutschlands, etc., ix, 1913, p. 27, fig. 32.

f. *fuellerbornei* (Schmidle), G. S. West, Journ. Linn. Soc., Bot., xxxviii, 1907, p. 106. (Syn.: *S. fuellerbornei*, Schmidle, Engler's Bot. Jahrb., xxxii, 1902, p. 76, Tab. III, fig. 2).

Sample 85.

The specimens in this sample resembled Schmidle's form, particularly as regards the zygospores, which had markedly pointed ends and a yellowish-brown membrane; the dimensions were, however, rather less (lat. zygosp., 32–33 μ ; long. zygosp., 50–60 μ), although exhibiting the same relative proportion between length and breadth. The vegetative filaments were 41–42 μ wide, the cells being three to six times as long as broad, and provided with three chloroplasts describing from one and a-half to two turns. The spiral bands were much broader than in Schmidle's specimens (*loc. cit.*, fig. 2, a), but it may be questioned whether too much stress can be laid on the width of the chloroplasts, which may well vary with local conditions of nutrition.

Schmidle compares his *S. fuellerbornei* with *S. neglecta* (Hass.), Kuetz., a much wider species, with slightly inflated fructifying cells and zygospores with rounded ends. G. S. West (*loc. cit.*) regards it as a tropical form of *S. decimina*, Kuetz., a view which finds further support in the specimens just described which seem to link up *S. fuellerbornei* with the typical *S. decimina*. Nevertheless it will be well for the present to maintain the form *fuellerbornei*, as distinguished by the possession of three chloroplasts (always?) by the very pointed ends of the zygospores, and by the slightly different dimensions.

var. *inflata*, F. E. Fritsch, nov. var. (Fig. 20).

Var. cellulis vegetativis latoribus et diametro vulgo 2–4-plo longioribus, chromatophoris 2 anfractibus $1\frac{1}{2}$ –2. Zygosporis aut fere globosis aut plus minus oblongo-ellipticis, apicibus late rotundatis raro subacutis, cellulas sporiferas non vel fere complementibus. Membrana zygosporae crassa laevis hyalina vel plus minus fusca. Cellulae fructiferae non inflatae, saepe breviores quam cellulas vegetativas. Cellulae filorum masculorum et (?) feminarum quae non conjugant semper magis inflatae.

Lat. cell. veg., 48–52 μ ; long. cell. veg., 81–180 μ ; lat. cell. non conj., 69–75; lat. $\times$ long. zygosp., 49 $\times$ 75, 54 $\times$ 81, 54 $\times$ 66, 52 $\times$ 49, 51 $\times$ 87, 55 $\times$ 57, 51 $\times$ 100 μ .

Sample 316 (common).

This variety is considerably larger than the type, but it is especially distinguished by the fact that the zygospores usually have broadly rounded and not pointed ends and that the non-conjugating cells in conjugating threads are markedly inflated. This inflation has been observed more particularly in the male filaments (Fig. 20, A, D), but it would also appear to occur occasionally in the female (*cf.* Fig. 20, I). The filaments containing zygospores had, however, mostly dissociated into the individual

cells, and, as a consequence, it has been difficult to obtain conclusive evidence on this point. Even the thread shown in Fig. 20, *I*, is not beyond suspicion, as the second cell from the left was empty, although

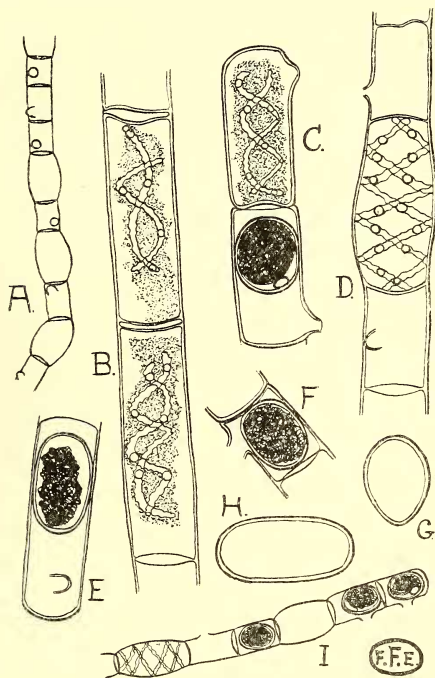


FIG. 20.—*Spirogyra decimina* (Muell.), Kuetz., var. *inflata*, F. E. Fritsch, nov. var. *A*, male thread, showing the empty conjugating cells and the inflated non-conjugating ones. *B*, two vegetative cells (the contents are shown contracted, as they appeared in the material). *C*, small part of a female thread showing an almost globular zygospore and a non-inflated vegetative cell. *D*, small part of a male thread, on a larger scale than in *A*. *E-H*, different forms of zygospores. *I*, female threads showing zygospores, a possible male cell, and inflated vegetative cells. *A* and *I* $\times 90$; the remaining figures $\times 225$.

provided with a conjugation canal, indicating the possibility that here conjugation with a third thread had taken place, the cell in question having behaved as a male.

The cells containing the zygospores never showed any trace of inflation, although generally rather short as compared with the ordinary vegetative

cells (*cf.* Fig. 20, *C, F, I*). As a general rule the zygospores only occupied a part of the fructifying cells (Fig. 20, *C, E*), but in some cases they almost completely filled them (Fig. 20, *F, I*). The zygospores were provided with a smooth thick membrane, generally brownish in colour, and varied very much in shape; the commonest type is shown in Fig. 20, *E* and *F*, but almost globular zygospores (Fig. 20, *C*) and such as were elongated elliptical (Fig. 20, *H*) were not infrequent. The ends were almost invariably broadly rounded (Fig. 20, *C, E, F, H*), but now and again one (Fig. 20, *G*) or, very rarely, both ends were somewhat pointed, this constituting an approach to the form of zygospore characteristic of the type. Not uncommonly small drops of oil occurred between the thick membrane and the slightly contracted contents (Fig. 20, *C, I*). The ordinary vegetative cells are not inflated, and appear in all cases to contain two chloroplasts (Fig. 20, *B-D*).

In some respects this variety resembles *S. exilis*, W. & G. S. West (Ann. Roy. Bot. Gard., Calcutta, vi, 1907, p. 186, Pl. X, figs. 11-13); this species is, however, considerably smaller, and shows the inflation of the non-conjugating cells only in the female filaments. Possibly, however, *S. exilis* would be better regarded as a variety of *S. decimina*.

The latter species is evidently of wide distribution in Africa, having been recorded from the Nyassa and Tanganyika region by G. S. West, from the Nyassa region by Schmidle (*f. fuellebornei*), from Madagascar by W. & G. S. West, and from Egypt by G. S. West.

2. *Spirogyra subreticulata* F. E. Fritsch, n. sp. (Fig. 21).

S. cellulis vegetativis diametro ad 8plo longioribus, extremitatibus non replicatis, septis saepe crassis; chromatophoris 3-4, saepe angustis, marginibus subintegris, anfractibus 2-3 vel interdum subrectis, cum pyrenoidibus conspicuis; conjugatione scalariformi, cellulis fructiferis interdum paullo in media parte inflatis, cellulis vegetativis brevioribus; zygosporis saepe tubis connexivis oppositis, lateres cellularum fructiferarum areti tangentibus sed in directione longitudinali eas non complentibus, oblongo-ellipticis polis acutis vel subrotundatis, interdum fere subcircularibus, diam circ. $1\frac{1}{2}$ - $2\frac{1}{2}$ plo longioribus; membrana zygosporae crassissima, laminis ternis praedita, lamina externa tenui hyalina persistente, lamina media irregulariter reticulata luteo-fusca, lamina interna crassa brunnea.

Crass. cell. veg., 50-54 μ ; crass. cell. fruct., 51-60 μ ; lat. $\times$ long. zygosp., 60 $\times$ 48, 63 $\times$ 45, 70 $\times$ 42, 87 $\times$ 54, 91 $\times$ 54, 93 $\times$ 49, 94 $\times$ 48, 96 $\times$ 54, 124 $\times$ 49 μ ; crass. membr. zygosp., 7-9 μ .

Samples 338, 339, and 340.

In many respects, and especially in the character of the zygospores, this species approaches *S. reticulata*, Nordst., but there are several points

of difference, viz. the threads are wider, the end-walls are not folded, there appear to be constantly three or four chloroplasts showing either a number of turns or, more rarely, running almost longitudinally, the fructifying cells are often not inflated, and, when inflation occurs, it is very slight, and the membrane of the zygospore is much thicker.

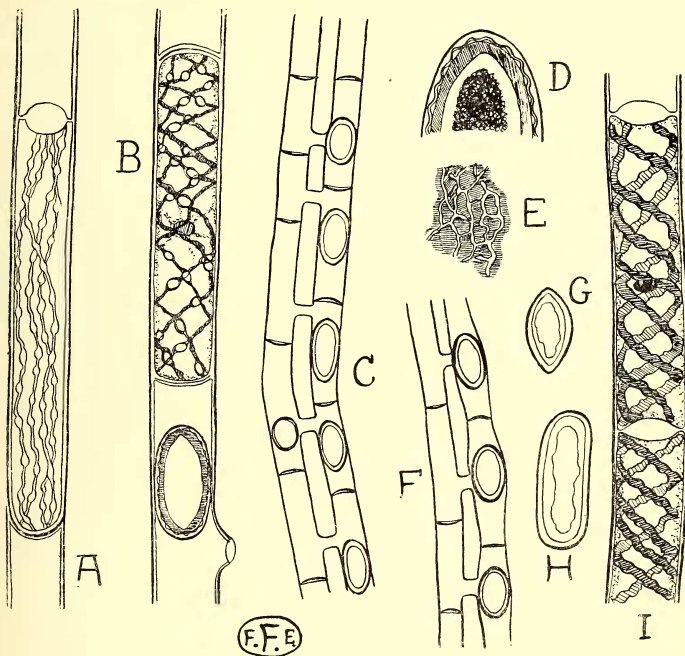


FIG. 21.—*Spirogyra subreticulata*, F. E. Fritsch, n. sp. A and I, portions of two vegetative filaments showing the varying disposition of the chloroplasts and the thick septa. B, C and F, threads with zygospores. D, part of a zygospore, on a large scale, in optical section to show the structure of the wall. E, surface-view of a small portion of the wall showing the reticulation of the middle layer. G and H, extreme forms of zygospores. A, B and I $\times 260$; C and F $\times 90$; D $\times 430$; E $\times 860$; G and H $\times 170$.

The zygospores are rather variable as regards relation of length to breadth and also in respect of their shape. Extreme forms are shown in Fig. 21, G and H, but most commonly they are elliptical, often with somewhat pointed ends (Fig. 21, C and F). The very thick zygospore-membrane is composed of three distinct layers (Fig. 21, D); there may

be a fourth delicate innermost layer, but it has been impossible to arrive at a definite conclusion on this point. The outermost layer is thin, smooth and hyaline, the next is somewhat thicker, with a more or less regular reticulate sculpturing (Fig. 21, *D* and *E*) and apparently yellowish-brown colour, whilst the third is very thick, seemingly homogeneous and dark brown. The conjugating cells are generally appreciably shorter than the ordinary vegetative cells (Fig. 21, *C* and *F*), and the cells containing the zygospores are often in no way inflated (Fig. 21, *C*), although here and there a slight inflation of the middle portion is apparent (Fig. 21, *F*).

The number of chloroplasts is often three (Fig. 21, *I*), more rarely four (Fig. 21, *A* and *B*). In the sterile filaments the chloroplasts were fairly broad and the pyrenoids often not very conspicuous (Fig. 21, *I*), but in conjugating threads they usually appeared narrower, the pyrenoids forming prominent bulges (Fig. 21, *B*).

S. subreticulata may also be compared with *S. cylindrospora*, W. & G. S. West, *S. borysthenica*, Kassin et Smirnoff, and *S. paraguayensis*, Borge, all of which show prominent points of difference.

3. *Spirogyra majuscula*, Kuetzing, Spec. Alg., 1849, p. 441: Tab. Phycol., v, 1855, Pl. XXVI, fig. 1. (Syn.: *S. orthospira*, Naeg.; Petit, *op. cit.*, p. 30, Pl. X, figs. 4, 5.)

Samples 64, 65 (common).

Lat. fil., 81–87 μ ; crass. zygosp., 48–54 μ ; long. zygosp., 72–91 μ . The vegetative cells were on the whole relatively short, rarely more than twice as long as broad and often not longer than broad. The dimensions, both of vegetative cells and zygospores, are larger than those given by Petit (*loc. cit.*), but in all other respects the material was quite typical.

4. *Spirogyra bellis* (Hass.), Cleve, Svenska Zygne., p. 18, Pl. III, figs. 2–5; Petit, *op. cit.*, p. 31, Pl. X, figs. 1–3. (Syn.: *Zygnema belle*, Hassall, Brit. Freshw. Alg., 1845, p. 142, Pl. XXIV, figs. 1, 2.)

Sample 327 (common).

Lat. fil., 90–96 μ ; crass. zygosp., 51–60 μ ; long. zygosp., 72–84 μ . The form present resembled more closely that figured by Hassall (*loc. cit.*) than that of Petit (*loc. cit.*), the vegetative cells being very short (as long as broad or $1\frac{1}{2}$ times as long) and the zygospores having broadly rounded ends. It differed from both, however, in showing slightly larger dimensions, in the zygospores not so completely filling the fructifying cells, and in the fact that the inflation of the latter was quite commonly not very pronounced. The middle layer of the zygospore-membrane showed a faint irregular scrobiculation like that described and figured by Borge (Arkiv f. Bot., vi, No. 1, 1906, p. 11, Tab. I, fig. 3).

5. *Spirogyra fluvitilis*, Hilse in Rabenhorst, Algen, No. 1476; Borge, *op. cit.*, p. 27, fig. 33.

var. *africana*, F. E. Fritsch, nov. var. (Fig. 22).

Var. cellulis vegetativis latioribus, saepe elongatis, membranis crassis, in parte inferiore florum etiam crassissimis, chromatophoris 3-4 anfractibus $1\frac{1}{2}$ -4; cellulis fructiferis valde inflatis, abbreviatis; zygosporis ovalibus, apicibus late rotundatis, cellulas sporiferas non vel fere complentibus. Membrana zygosporae crassa ferruginea, lamina media irregulariter sed dense reticulata. Cellula radicalis plus minus elongata, rhizoidiformis et

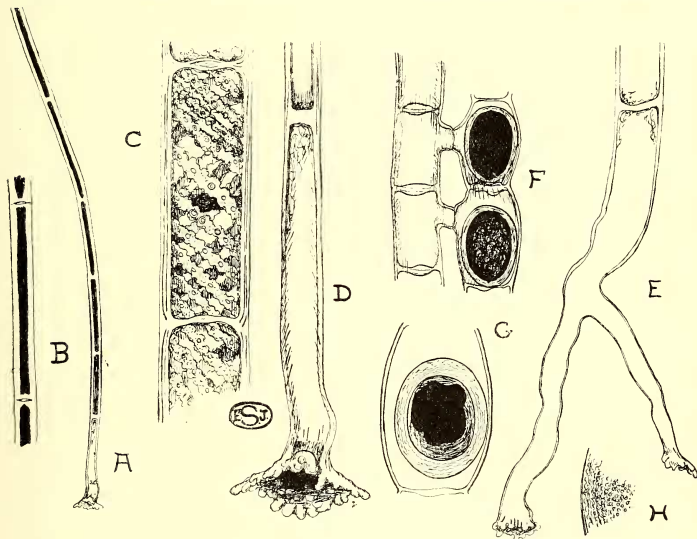


FIG. 22.—*Spirogyra fluviatilis*, Hilse, var. *africana*, F. E. Fritsch, nov. var. A, base of a filament showing the attaching cell and the thick-walled cells following upon it. B, a single one of the latter, on a larger scale. C, ordinary vegetative cells. D, rhizoid of the ordinary, and E, rhizoid of the branched type. F, small part of threads in process of conjugation. G, zygospore, showing structure of the membrane. H, small part of the latter, on a larger scale. A $\times 30$; B $\times 60$; C and G $\times 300$; D-F $\times 135$; H $\times 700$ about.

vulgo contentu nullo, cellulae posteriores aut formae vulgaris aut membrana valde incrassata et contentu diminuto.

Lat. cell. veg., $54-60\ \mu$; long. 3-10plo major; lat. cell. fruct., $90-96\ \mu$; crass. zygosp., $63-67\ \mu$; long. zygosp., $78-79\ \mu$ (raro longior).

Sample 331 (common, probably attached to stones in clear running water).

This variety differs from the published descriptions of *S. fluviatilis*, Hilse, in the wider vegetative cells, the frequent presence of three chloroplasts (although four are not uncommon), and in the dense reticulation of

the middle layer of the zygospore-membrane. This seems to be due to the fact that the lamellae of the middle layer are undulate, these undulations appearing as wavy lines, and, when viewed exactly from above, as dots or little papillae (cf. Fig. 22, *G* and *H*). It is possible that this feature of the zygospore is not really distinctive of the variety, as earlier observers may not have had mature zygospores of *S. fluviatilis* before them; immature zygospores, in the present material, showed no trace of the reticulation. Altogether our knowledge of *S. fluviatilis* is so meagre that it has been difficult to arrive at an exact conclusion as to the status of the present form.

The cell-walls, both longitudinal and transverse, are strongly thickened and often lamellated (Fig. 22, *C*). The conjugation-tubes are broad, thick-walled and very short (Fig. 22, *F*), as appears to be characteristic of *S. fluviatilis* (cf. Borge's figure, *loc. cit.*). Many of the threads showed well-marked attaching cells (Fig. 22, *A*), generally simple (Fig. 22, *A* and *D*), but occasionally branched (Fig. 22, *E*). The cells immediately following on these rhizoids were either of the ordinary type, or several of them were exceedingly thick-walled and provided with very attenuated contents in which no details of structure could be distinguished (Fig. 22, *A* and *B*); now and again similar cells were observed in the course of the filaments.

This variety somewhat approaches *S. fallax* (Hansg.), Wille (*S. insignis* (Hass.), Kuetz., var. *fallax*, Hansg., Hedwigia, 1888), in which the middle layer of the membrane of the elliptical zygospores is brown with reticulate thickenings; but this species frequently possesses folded end-walls, the chloroplasts run almost straight or exhibit fewer turns, and it does not appear to have special attaching cells in the mature condition.

6. *Spirogyra rivularis* (Hass.), Rabenhorst, Fl. Europ. Alg., iii, 1868, p. 243. (Syn.: *Zygnema rivularis*, Hassall, Brit. Freshw. Alg., 1845, p. 144, Pl. XXVII, figs. 1, 2.) (Fig. nostr. 23.)

Samples 70 (common) and 71.

Lat. cell. veg., 37–40 μ ; long., 96–180 μ ; crass. membr., 4.5–6 μ . I provisionally refer this form, of which only sterile material was present, to the above species, with which it seems to agree in dimensions, in the presence of two to three chloroplasts making several turns in the cells (Fig. 23, *A*), and in its habitat. The chloroplasts were very broad, with large pyrenoids, and were generally so densely arranged that it was difficult to distinguish the one from the other (Fig. 23, *A*). The membrane was usually very strongly thickened and stratified (Fig. 23, *A* and *B*), as also were the septa (which in extreme cases attained a thickness of 30 μ). The lower end of the filaments terminated in a characteristic strongly thickened attaching cell (Fig. 23, *B* and *C*), with a broadened base and scanty chlorophyll-content; in some few cases the cell next above was also provided with rather scanty contents. The upper ends of the filaments were neatly rounded off.

(NOTE.—Sterile, and therefore indeterminable, material of this genus was also encountered in the following samples : 33, 66 (several species), 86, 159, 311, 313, 314, 316, 327, 336, 339, and 344).

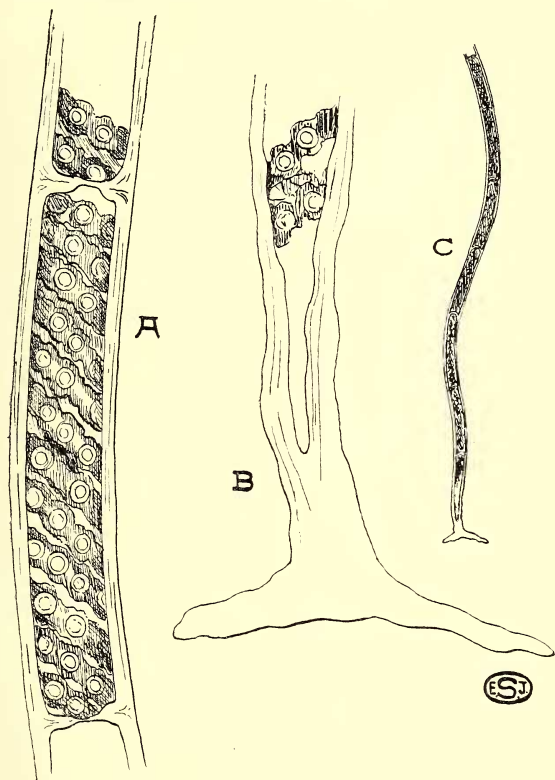


FIG. 23.—*Spirogyra rivularis* (Hass.), Rabenh. (?). A, small part of a filament showing the thick membrane and the arrangement of the chloroplasts. B, one of the attaching cells. C, base of a filament. A and B $\times 450$; C $\times 50$.

GENUS ZYGNEMA AGARDH.

1. *Zygnema pectinatum* (Vauch.), Agardh., Synops. alg. Scandin., 1817, p. 102; Borge, *op. cit.*, p. 33, fig. 49. (Syn.: *Zygogonium pectinatum*, Kuetz.). (Fig. nostr. 24.)

Samples 24 (rare), 36 (common, here like var. *conspicuum* (Hass.), Kirchn.).

Lat. cell. veg., 27 (sample 36) or $30\ \mu$ (sample 24); cells about twice as long; dimensions of zygospores, 40×33 (sample 36) or $40 \times 36\ \mu$ (sample 24).

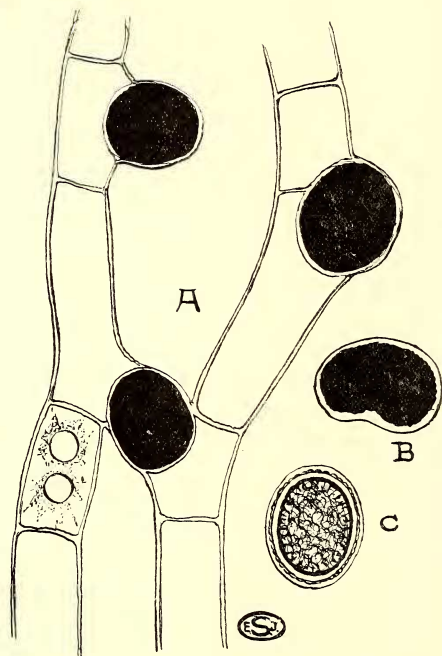


FIG. 24.—*Zygnema pectinatum* (Vauch.), Ag. A. Filaments showing both scalariform and lateral conjugation. B. Kidney-shaped zygospore, produced by lateral conjugation. C. Zygospore showing the characters of the membrane. $\times 500$.

The material in sample 36 contained very plentiful conjugating filaments and zygospores, the bulk of the latter being immature; here and there, however, typical mature spores, spherical or slightly elliptical in shape, with a brown and reticulate middle membrane were encountered (Fig. 24, C). The material was peculiar in the fact that many of the threads exhibited lateral conjugation, with formation of the zygospore, as in the ordinary method, in the middle of the conjugation-canal (Fig. 24, A), lateral and

scalariform conjugation often occurring in different parts of the same thread (Fig. 24, A). Lateral conjugation, among the species of the section *Zygogonium*, has hitherto only been observed in *Z. rhynchonema*, Hansg., which is a smaller species with more elongated cells. The zygospores

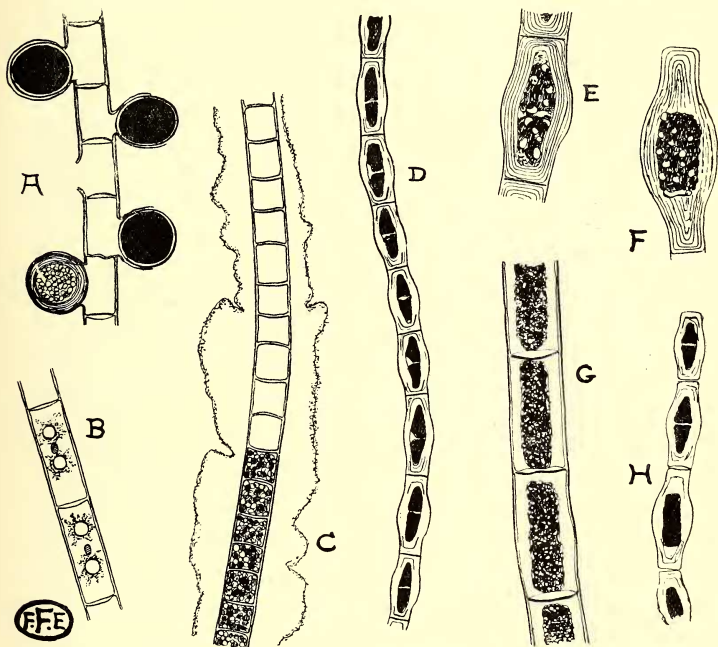


FIG. 25.—A-C, *Zygnema cyanospermum*, Cleve, forma. A, filament with zygospores. B, ordinary vegetative cells. C, probable resting stage. D-H, *Zygnema pectinatum* (Vauch.), Ag. (?), akinete-formation. D and H, threads with mature akinetes, in H in process of splitting apart. E, F, separate akinetes. G, part of a filament at an early stage in akinete-formation. A-C and E-G $\times 220$; D and H $\times 110$.

formed by lateral conjugation were either of the normal shape (Fig. 24, A), or often somewhat curved and almost kidney-shaped (Fig. 24, B).

Sample 36 contained abundant stages of a *Zygnema* forming akinetes*

* *Z. africanum*, n. sp., in litteris. It should be mentioned that these akinetes are altogether different from those described by De Bary for *Zygnema pectinatum* (cf. De Bary, Unters. Ueb. d. Familie der Conjugaten, 1858, pp. 9, 10, t. 1, figs. 15, 16), so that the possibility of their belonging to another species must be borne in mind.

which appear to be referable to *Z. pectinatum* (Fig. 25, *D-H*). The first step appears to consist in a marked thickening of the membrane, the thickening sometimes showing some stratification, though this is frequently obscure at this stage (Fig. 25, *G*). At the same time the cell-contents become densely crowded with food-bodies which seem in the main to be of the nature of oil-globules; this accumulation may altogether hide the two chloroplasts (Fig. 25, *G*), although in many cases their presence is indicated by a separation of the dense cell-contents into two more or less distinct halves (Fig. 25, *D* and *H*). Subsequently, as the thickening of the membrane progresses, the cells become ventricose in the middle (Fig. 25, *D* and *H*); the swelling is, however, confined to the central part of the cell, the ends having straight parallel margins for some little distance (Fig. 25, *E, F*). At this stage the cells may be more than twice their original width in the middle. The septa mostly become especially strongly thickened, so that the cell-contents are relegated to the median swollen part (Fig. 25, *F*), although this thickening of the septa may apparently commence at a rather later stage than that of the longitudinal walls. Ultimately these septa split across the middle (Fig. 25, *H*) and the akinetes become free. Large numbers of such splitting threads and of isolated akinetes were encountered in the sediment of Sample 36. The individual akinetes either have neatly rounded truncate ends (*cf.* the upper end in Fig. 25, *F*) or the ends bear remnants of the thickening layers (lower end of Fig. 25, *F*).

It may be added that all stages between the normal thin-walled *Zygnema pectinatum* filament and such thick-walled threads as are shown in Fig. 25, *G*, were found, and seeing that the diameter of the cell-contents of the latter is the same as that of the former, it seems fairly safe to conclude that the akinetes are those of this species.

The following is a synopsis of the dimensions of these akinetes:—

	μ	μ	μ	μ	μ	μ	μ	μ
Width of cells as in Fig. 25, <i>G</i>	36	36	37	37	39	40	42	42.
Length „ „ „ „	—	100	105	83	129	135	170	165.
Thickness of membrane of ditto	3	6	6	4.5	2.5	7.5	—	7.5.
Width of akinete in the middle	—	60	70	73	67	57	—	—
Length of akinete	—	174	200	—	—	—	—	—
Thickness of membrane in middle	—	12	12	15	15	14	—	—
„ „ „ at the apex	—	60	66	—	—	—	—	—
Width of apex	—	30	30	—	—	—	—	—

2. *Zygnema cyanospermum*, Cleve, Svenska Zygnem., Nov. Act. Reg. Soc. sc. Upsal., ser. iii, vi, 1868, No. xi, p. 28, Pl. VIII, figs. 6-8.

forma paullo major, cellulis brevioribus, 1-3plo longioribus quam latis. Lat. cell. veg., 27-30 μ ; dimension. zygospor., 42 $\times$ 39, 42 $\times$ 43, 45 $\times$ 42, 48 $\times$ 48, 48 $\times$ 33 (elliptical zygospor.), 50 $\times$ 48 μ . (Fig. 25, *A-C*.)

Sample 311 (not uncommon, but mainly sterile).

Z. cyanospermum, Cleve, appears hitherto only to have been recorded by Cleve from Sweden and by Larsen from Greenland. The South African specimens do not entirely agree with Cleve's diagnosis and figure, but there can be no doubt that they belong to this species. The vegetative cells and the zygospores are somewhat larger, but in no case did the length of the cells amount to more than three times the breadth; in fact in many of the threads, in which active division had evidently taken place, the length

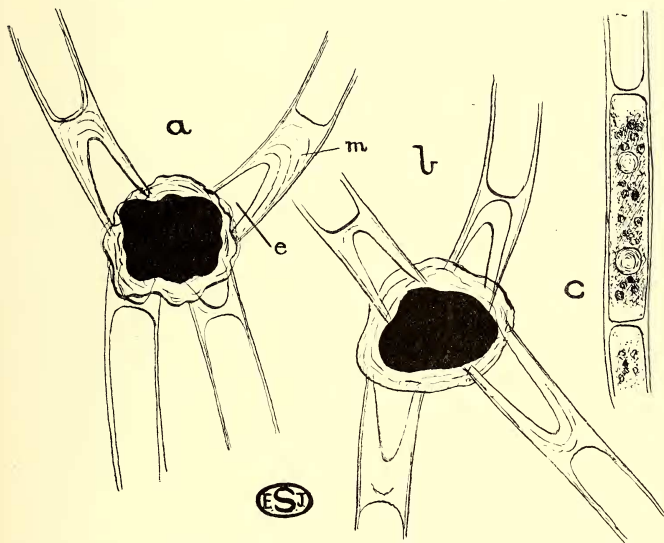


FIG. 26.—*Mougeotia uberosperma*, W. & G. S. West. *a* and *b*, cells with ripe zygospores. *c*, small part of a vegetative thread. *a* and *b* $\times 1000$; *c* $\times 900$.

of the cells scarcely exceeded their breadth. The zygospores were in part almost completely spherical (Fig. 25, *A*), but here and there an elliptical one was encountered. The outer layer of the zygospore-membrane is relatively thin and transparent, the second layer more or less strongly thickened (Fig. 25, *A*, lowest zygospore) and deeply pigmented, exhibiting various shades of blue, from a deep greenish-blue to a deep violet or practically black colouration.

Some of the sterile *Zygnema*-threads in the same sample, and presumably belonging to the same species, were provided with a wide and often irregular mucilage-sheath (Fig. 25, *C*). A few of these threads, with an especially

wide sheath, were composed of cells with dense granular contents including large shining drops of some oily material (Fig. 25, *C*). These are probably resting-stages of this species.

(NOTE.—Sterile, indeterminable material of *Zygnema* was also observed in samples 64, 65, 85, 86, 159, 312, 314, 316, and 327.)

(4) MESOCARPACEAE.

GENUS MOUGEOTIA AGARDH.

1. *Mougeotia uberosperma*, W. & G. S. West, Welwitsch's Afr. Freshw. Alg., Journ. of Bot., 1897, p. 37. (Fig. 26.)

Sample 36 (rare).

Lat. cell. veg., 7–9 μ ; long. cell. veg., 30–34 μ ; diam. zygosp. sine proc., 24–25 μ ; crass. membr. zygosp., 3·5–4·5 μ ; long. proc., usque 18 μ .

This small species has hitherto only been recorded from Huilla and its rediscovery in Kentani is interesting. The zygospores are very characteristic, being irregularly angular-globose (Fig. 26, *a* and *b*), with a thick, colourless, plainly stratified wall and bearing four processes of very unequal length. The processes are homogeneous and apparently mucilaginous in nature and are more or less pointed when long, though blunt when short (Fig. 26, *a* and *b*); they extend for a variable distance into the cavities of the conjugating cells. The unoccupied part of the latter would also appear in some cases to become filled up with some distinctly stratified material (Fig. 26, *a*, *m*).

(NOTE.—Sterile material of *Mougeotia* was also observed in samples 64, 66, 311, 312, 315, and 327.)

II. HETEROKONTAE.

(4) TRIBONEMACEAE.

GENUS OPHIOCYTIUM NAEGELI.

1. *Ophiocytiium majus*, Naegeli, Gatt. einzell. Alg., 1848, p. 89, Pl. IV, A, fig. 2; Heering, Suesswasseralg. Schleswig-Holsteins, etc., i, 1906, p. 120, fig. 25.

Sample 22.

Previously recorded from the Cape (Fritsch).

2. *Ophiocytiium parvulum* (Perty), A. Braun, Alg. unicell., etc., 1855, p. 55; Heering, *op. cit.*, p. 124, fig. 31.

Samples 20, 21, 22, 338, 339.

Previously recorded from the Cape (Fritsch).

3. *Ophiocytium cochleare* (Eichw.), A. Braun, *op. cit.*, p. 54; Heering, *op. cit.*, p. 121, fig. 26.

Samples 22, 338, 339.

Previously recorded from the Cape (Nordstedt).

4. *Ophiocytium gracilipes* (A. Braun), Rabenhorst, Fl. Europ. Alg., iii, 1868, p. 68; Heering, *op. cit.*, p. 118, fig. 24, a, d. (Syn.: *Sciadium gracilipes*, A. Braun.)

Sample 29 (rather common).

GENUS TRIBONEMA DERBÈS ET SOLIER.

1. *Tribonema bombycinum*, Derbès et Solier, Mém. sur q. points d. l. physiol. d. algues, Suppl. aux Comptes rendues, i, 1856, p. 18; Heering, *op. cit.*, p. 131, fig. 36. (Syn.: *Conferva bombycina*, Ag.).

Forma *minor*, Wille.

Samples 19, 20, 21, 22, 29, 86, 334, 342, 346.

Previously recorded from the Cape (Fritsch).

III. CYANOPHYCEAE (MYXOPHYCEAE).

(a) CHROOCOCCALES.

(1) CHROOCOCCACEAE.

GENUS CHROOCOCCUS NAEGELI.

1. *Chroococcus minutus* (Kuetz.), Naegeli, Gatt. einzell. Alg., 1849, p. 46; Forti, Sylloge Myxophyc., 1907, p. 14.

Sample 326 (rather common).

Previously recorded from South Africa (Wille), Great Namaqualand (G. S. West), and the Cape (Fritsch).

2. *Chroococcus minor* (Kuetz.), Naegeli, *op. cit.*, p. 47, Pl. I, a, fig. 4; Forti, *op. cit.*, p. 23.

Sample 71.

Previously recorded from the Karoo, Little and Great Namaqualand (G. S. West).

3. *Chroococcus turgidus* (Kuetz.), Naegeli, *op. cit.*, p. 46; Forti, *op. cit.*, p. 11. (Syn.: *Protococcus turgidus*, Kuetzing, Tab. Phycol., i, Tab. VI, fig. 1.)

Samples 158, 159, 311, 314, 315 (rather common), 324 (here on *Phormidium fragile*), 326 (very rare).

Diam. cell., 10–30 μ .

Previously recorded from the Cape region, Little Namaqualand, and Holle River (G. S. West).

GENUS GLOEOTHECE NAEGELI.

1. *Gloeotheca linearis*, Naegeli, *op. cit.*, p. 58, Tab. I, α, fig. 2; Forti, *op. cit.*, p. 62.

Samples 159 (rare) and 324 (very common).

Lat. cell., 2-2.5 μ ; long. cell., 10-15 μ . The sheaths of the individual cells were very difficult to decipher, even after staining. The cells were very variable in form, short straight rods with rounded or pointed ends being most common, but lunate and faintly sigmoid shapes were not infrequent. A few cells were also observed in which one side was flat and the other convex.

2. *Gloeotheca confluens*, Naegeli, *op. cit.*, p. 58, Tab. I, α, fig. 1; Forti, *op. cit.*, p. 60.

Sample 159.

GENUS APHANOTHECE NAEGELI.

1. *Aphanotheca microscopica*, Naegeli, *op. cit.*, p. 59, Tab. I, η, fig. 1; Forti, *op. cit.*, p. 83.

Sample 85.

GENUS MICROCYSTIS KUETZING.

1. *Microcystis parasitica*, Kuetzing, *Phycol. generalis*, 1843, p. 170; *Phycol. german.*, 1845, p. 148; Tab. *Phycol.*, i, 1846, Tab. IX; Forti, *op. cit.*, p. 91; Fritsch, *Freshw. Alg., Nat. Antarct. Exped.*, vi, 1912, p. 24, Pl. I, figs. 67-70. (Syn.: *Microcystis firma* (Bréb. et Lenorm.), Migula.)

Sample 324 (common, on *Phormidium fragile*.)

2. *Microcystis chroococcoidea*, W. & G. S. West, *Freshw. Alg., Brit. Antarct. Exped.* 1907-9, vii, 1911, p. 296, Pl. XXVI, figs. 107-114.

Sample 324 (rather rare, on *Phormidium fragile*.)

Colonies of small cells (diam., 4 μ). This species has hitherto only been recorded from the Antarctic (by W. & G. S. West and F. E. Fritsch).

GENUS GOMPHOSPHAERIA KUETZING.

1. *Gomphosphaeria aponina*, Kuetzing, *Alg. aq. dulc. german.*, Decas 16, 1836, No. 151; Tab. *Phycol.*, i, 1846, p. 22, Tab. XXXI, fig. 3; Forti, *op. cit.*, p. 97.

Samples 159 (common), 312, 325, 326.

Previously recorded from Little Namaqualand (G. S. West).

GENUS COELOSPHAERIUM NAEGELI.

1. *Coelosphaerium kuetzingianum*, Naegeli, *op. cit.*, p. 54, Tab. I, c ; Forti, *op. cit.*, p. 100.

Sample 158 (rare).

GENUS MERISMOPEDIA MEYEN.

1. *Merismopedia glauca* (Ehrenb.), Naegeli, *op. cit.*, p. 55, Pl. I, D, fig. 1 ; Forti, *op. cit.*, p. 105.

Samples 159 (common), 311, 312, 314, 315 (in the last rather common).

Previously recorded from South Africa (Wille), Little Namaqualand (G. S. West), and Orange Free State (Fritsch).

2. *Merismopedia punctata*, Meyen, in Wiegman, Archiv, 1839, p. 67 ; Kuetzing, Tab. Phycol., v, 1855, Tab. XXXVIII, fig. 3 ; Forti, *op. cit.*, p. 106.

Sample 159 (rather common).

Previously recorded from Little Namaqualand (G. S. West).

(2) GLAUCOCYSTACEAE.

GENUS GLAUCOCYSTIS ITZIGSOHN.

1. *Glaucocystis nostochinearum*, Itzigsohn, in Rabenhorst, Alg. exsicc., No. 1935 ; Fl. Europ. Alg., iii, 1868, p. 417, fig. ; Forti, *op. cit.*, p. 693.

Sample 36 (very rare).

(b) CHAMAESIPHONALES.

(1) CHAMAESIPHONACEAE.

GENUS CHAMAESIPHON BRAUN ET GRUNOW.

1. *Chamaesiphon incrustans*, Grun. ; Rabenhorst, *op. cit.*, ii, 1865, p. 149 ; Forti, *op. cit.*, p. 136.

Samples 325 (on *Cladophora*, sp.), and 331 (on *Spirogyra fluvialis* var. *africana* and *Oedogonium*, sp.).

Previously recorded from Orange Free State (Fritsch).

(e) HORMOGONEALES.

(1) OSCILLATORIACEAE.

GENUS OSCILLATORIA VAUCHER.

1. *Oscillatoria princeps*, Vaucher, Hist. d. Conferv. d'eau douce, 1803, p. 190, Tab. XV, fig. 2 ; Gomont, Monogr. d. Oscillariées, Ann. sci. nat., sér. 7, xvi, 1893, p. 206, Pl. VI, fig. 9.

Sample 161 (rather common).

Diam. trich., 21–30 μ .

Previously recorded from the Karoo by G. S. West.

2. *Oscillatoria sancta*, Kuetzing, Tab. Phycol., i, 1845, p. 30, Tab. XLII, fig. 7; Gomont, *op. cit.*, p. 209, Pl. VI, fig. 12.

Sample 326 (common).

Diam. trich., 16 μ .

3. *Oscillatoria limosa*, Agardh, Disp. Alg. Suec., 1812, p. 35; Gomont, *op. cit.*, p. 210, Pl. VI, fig. 13.

Sample 158 (rather rare).

Previously recorded from Holle River, Calvinia Division (G. S. West), and Orange Free State (Fritsch).

4. *Oscillatoria tenuis*, Agardh, Alg. Decades, ii, 1813, p. 25; Gomont, *op. cit.*, p. 220, Pl. VII, figs. 2, 3.

Samples 23, 24, 28 (here very rare), 336.

Previously recorded from Holle River, Calvinia Division (G. S. West), Little Namaqualand (G. S. West), the Cape (Fritsch), and Madagascar (Fritsch).

5. *Oscillatoria geminata*, Meneghini, Consp. alg. eugan., 1837, p. 9; Gomont, *op. cit.*, p. 222, Pl. VII, fig. 6.

Sample 346 (common).

6. *Oscillatoria splendida*, Greville, Fl. edinensis, 1824, p. 305; Gomont, *op. cit.*, p. 224, Pl. VII, figs. 7, 8.

Sample 324 (common).

Forming dense tufts on the surface of *Phormidium fragile*; diam. trich., 2.5–3 μ .

7. *Oscillatoria animalis*, Agardh, in Flora, x, 1827, p. 632; Gomont, *op. cit.*, p. 227, Pl. VII, fig. 13.

Samples 161, 312.

Previously recorded from Little Namaqualand (G. S. West), and South Africa (Wille).

8. *Oscillatoria brevis*, Kuetzing, Phyc. generalis, 1843, p. 186; Gomont, *op. cit.*, p. 229, Pl. VII, figs. 14, 15.

Sample 86.

9. *Oscillatoria formosa*, Bory, Dict. Class. d'hist. Nat., xii, 1827, p. 474; Gomont, *op. cit.*, p. 230, Pl. VII, fig. 16.

Samples 324, 326.

Diam. trich., 6 μ .

Previously recorded from Little Namaqualand (G. S. West) and the Cape (Fritsch).

10. *Oscillatoria subtilissima*, Kuetzing, Tab. Phycol., i, 1845, p. 27, Tab. XXXVIII, fig. 8; Forti, *op. cit.*, p. 171.

Sample 335 (rather common).

This form occurred on the surface of the investment of *Nostoc* sp. The trichomes (diam., $1.5\ \mu$) in part formed almost parallel bundles, in part were rolled up in a circinate manner. They showed a faint constriction at the dissepiments, which were fairly conspicuous. It has been suggested that this species may be a form of *Lyngbya rivulariorum*, Gom. (*cf.* Ann. S. Afr. Mus., ix, 1918, p. 574), and the mode of occurrence of the present material is not in disagreement with this.

GENUS SPIRULINA TURPIN.

1. *Spirulina major*, Kuetzing, Phycol. generalis, 1843, p. 183; Gomont, *op. cit.*, p. 251, Pl. VII, fig. 29.

Sample 326 (rather rare).

Previously recorded from Little Namaqualand (G. S. West), the Cape and Orange Free State (Fritsch).

GENUS PHORMIDIUM KUETZING.

1. *Phormidium fragile*, Gomont, *op. cit.*, p. 163, Pl. IV, figs. 13-15.

Sample 324 (bearing numerous epiphytes: *Oscillatoria splendida*, *Lyngbya aestuarii*, *Chroococcus turgidus*, *Microcystis* spp., *Microcoleus chthonoplastes*, *Anabaena torulosa*).

Previously recorded from Holle River (G. S. West).

2. *Phormidium valderianum*, Gomont, *op. cit.*, p. 167, Pl. IV, fig. 20.

Sample 159 (rather common).

Previously recorded from Cape Town (Fritsch).

3. *Phormidium laminosum*, Gomont, *op. cit.*, p. 167, Pl. IV, figs. 21, 22.

Sample 81.

Previously recorded from Little Namaqualand and Holle River (G. S. West).

4. *Phormidium tenue*, Gomont, *op. cit.*, p. 169, Pl. IV, figs. 23-25.

Samples 71, 85.

Previously recorded from Holle River and Little Namaqualand (G. S. West).

5. *Phormidium inundatum*, Kuetzing, Spec. Alg., 1849, p. 251; Gomont, *op. cit.*, p. 172, Pl. IV, figs. 31, 32.

Sample 68.

Diam. fil., $4-6\ \mu$.

6. *Phormidium subfuscum*, Kuetzing, Phycol. generalis, 1843, p. 195 ; Gomont, *op. cit.*, p. 182, Pl. V, figs. 17-20.

Sample 326.

Diam. fil., 10-11 μ .

Previously recorded from Table Mountain (Fritsch).

7. *Phormidium autumnale*, Gomont, *op. cit.*, p. 187, Pl. V, figs. 23, 24. (Syn.: *P. uncinatum*, Gom.)

Samples 69, 79, 82, and 84.

Previously recorded from the Cape Province (Fritsch).

GENUS LYNGBYA C. AGARDH.

1. *Lyngbya aestuarii*, Liebman, Bemerkn. og till. dansk. Algefl., Kroeyer's Tidsskrift, 1841, p. 492 ; Gomont, *op. cit.*, p. 127, Pl. III, figs. 1, 2. Sample 324 (rather common, on *Phormidium fragile*).

Diam. fil., 18-20 μ .

2. *Lyngbya major*, Meneghini, Consp. alg. eugan., 1837, p. 12 ; Gomont, *op. cit.*, p. 144, Pl. III, fig. 15.

Sample 24 (rare).

Previously recorded from South Africa (Wille), Little Namaqualand (G. S. West), and the Cape (Fritsch).

3. *Lyngbya aerugineo-coerulea*, Gomont, *op. cit.*, p. 146, Pl. IV, figs. 1-3. Sample 329 (rather common).

Diam. trich., 4-5 μ . The trichomes did not exhibit any specially differentiated apical cell, although there was sometimes a slight thickening of the outer wall of the end-cell. The septa were often very indistinct and not granulated and the cell-contents in many of the trichomes very homogeneous. Such forms come very close to *L. cladophorae*, Tilden (Minnesota Algae, i, 1910, p. 116, Pl. V, fig. 34), which is probably but a form of *L. aerugineo-coerulea*. The species has been previously recorded from Table Mountain (Fritsch).

4. *Lyngbya kuetzingii*, Schmidle, Algol. Not., iv, Allgem. bot. Zeitschr., 1896, p. 58 ; Forti, *op. cit.*, p. 280.

Var. *distincta* (Nordst.), Lemmermann, Engler's Bot. Jahrb., xxxiv, 1905, p. 620. (Syn.: *L. subtilis*, W. West ; *L. distincta*, Schmidle.)

Sample 24 (rather common, on *Vaucheria* sp.).

Lat. fil., 1.8 μ .

Previously recorded from the Cape (Fritsch).

GENUS MICROCOLEUS DESMAZIÈRES.

1. *Microcoleus chthonoplastes*, Thuret, Essai d. classif. d. Nostochinées, Ann. sci. nat., sér. 6, Bot., i, 1875, p. 378; Gomont, *op. cit.*, xv, 1893, p. 353, Pl. XIV, figs. 5-8.

Sample 324 (rare, on *Phormidium fragile*).

Diam. trich., 6 μ .

GENUS SCHIZOTHRIX KUETZING.

1. *Schizothrix calcicola*, Gomont, *op. cit.*, p. 307, Pl. VIII, figs. 1-3.

Sample 345 (common).

(2) NOSTOCACEAE.

GENUS NOSTOC VAUCHER.

1. *Nostoc caeruleum*, Lyngb.; Bornet et Flahault, Rev. d. Nostoc. hétérocyst., Ann. sci. nat., Bot., sér. 7, vii, 1888, p. 213; Forti, *op. cit.*, p. 416.

Sample 82.

2. *Nostoc muscorum*, Agardh, Disp. Alg. Suec., 1812, p. 44; Bornet et Flahault, *op. cit.*, p. 200; Forti, *op. cit.*, p. 400.

Sample 85 (with spores).

In sample 87 there occurred another *Nostoc* which may possibly belong to this species; the material, however, showed no spores and was poorly preserved.

3. *Nostoc* sp. (*verrucosum* (L.), Vauch.?).

Sample 335.

In the absence of spores it is not possible to make sure of this determination. The trichomes were very regularly cylindrical, the cells depressed-spherical, and the heterocysts spherical. Diam. cell., 4 μ ; diam. heterocyst., 7-8 μ .

GENUS ANABAENA BORY.

1. ? *Anabaena inaequalis* (Kuetz.), Bornet et Flahault, *op. cit.*, p. 231. (Fig. 27.)

Sample 29 (for the most part epiphytic on *Oedogonium* sp.).

This is the same form as has been recorded from Camps Bay in the Cape Peninsula and from Riet River, Orange Free State (*cf.* Fritsch, *loc. cit.*, p. 578). It has a marked epiphytic tendency, occurring in the present sample mainly on a species of *Oedogonium*. The trichomes are often rather straight and are provided with a delicate close-fitting sheath (Fig. 27, B);

not uncommonly several of them occur together in a common sheath (Fig. 27, *A*). The vegetative cells are $5-6\ \mu$ in diameter (rather wider dimensions were observed in the other South African material); the heterocysts are slightly wider and spherical or somewhat elliptical in shape (Fig. 27).

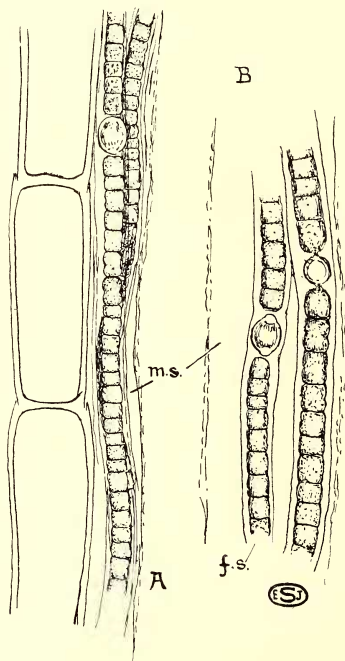


FIG. 27.—*Anabaena inaequalis* (Kuetz.), Bornet et Flahault (?). *A*, showing several trichomes in a common sheath. *B*, separate trichomes. *m.s.*, mucilage-sheath; *f.s.*, sheath of individual trichome. $\times 1000$.

This form has been referred to the above species because of its general habit and other points of agreement, but in the absence of spores the reference is uncertain. The frequent elliptical shape of the heterocysts is a point of divergence, but it may be noted that G. S. West (Brit. Freshw. Alg., 1904, p. 328, fig. 150, *B*, *C*) figures heterocysts, which are elliptical, for this species.

2. *Anabaena torulosa* (Carn.), Lagerheim, Bidr. Sv. Algfl., Oefvers. K. Vet.-Akad. Foerhandl., 1883, No. 2, p. 47; Bornet et Flahault, *op. cit.*, p. 236.

Sample 324 (rare, on surface of *Phormidium fragile*).

Diam. cell., $4.5\ \mu$; diam. heterocyst., $6\ \mu$; lat. spor., $6-7.5\ \mu$; long. spor., $15-18\ \mu$. Spores contiguous to heterocysts, often somewhat hour-glass-shaped. This species does not appear to be very sharply distinguished from *A. catenula* (Kuetz.), Bornet et Flahault.

(NOTE.—An indeterminable species of *Anabaena* was also observed in sample 327.)

(3) SCYTONEMATACEAE.

GENUS SCYTONEMA AGARDH.

1. *Scytonema* sp. (*stuposum* (Kuetz.), Bornet?).

Sample 327.

Diam. fil., $21-27\ \mu$; diam. trich., $18-20\ \mu$. Heterocysts flattened, sometimes hour-glass-shaped; cell-contents often violet. The material was inadequate for satisfactory determination.

(4) STIGONEMATACEAE.

GENUS STIGONEMA AGARDH.

1. *Stigonema turfaceum* (Berkeley), Cooke, Brit. Freshw. Alg., 1882-84, p. 272, Pl. CXI, fig. 2; Bornet et Flahault, *op. cit.*, sér. 7, v, 1887, p. 74.

Sample 36 (rare).

Diam. fil., $33\ \mu$.

(5) RIVULARIACEAE.

GENUS CALOTHRIX AGARDH.

1. *Calothrix gracilis*, F. E. Fritsch, Freshw. Alg., in Rep. Nat. Antarc. Exped., vi, 1912, p. 37, Pl. III, figs. 164-172.

Forma *flexuosa*, n. f. (Fig. 28).

Filis plerumque valde flexuosis, gregariis, cellula apicali saepe subacuta. Diam. fil. ad bas., $6-7\ \mu$; diam. trich. ad bas., $5-6\ \mu$; diam. fil. in media parte, $4-5\ \mu$; diam. trich. in media parte, $3-3.5\ \mu$; diam. heterocyst., $5-6\ \mu$; diam. spor. immatur., $6\ \mu$, long., $9\ \mu$.

Sample 327 (common as an epiphyte on fragments of water-plants and on filaments with zygospores of *Spirogyra bellis*).

This differs somewhat from the Antarctic form originally described, especially in the highly flexuous character of the filaments, which are often very densely aggregated on the substratum, and in the fact that the apical cells of the trichomes are usually more rounded than in the type, being bluntly pointed rather than conical. The material, however, agrees in all

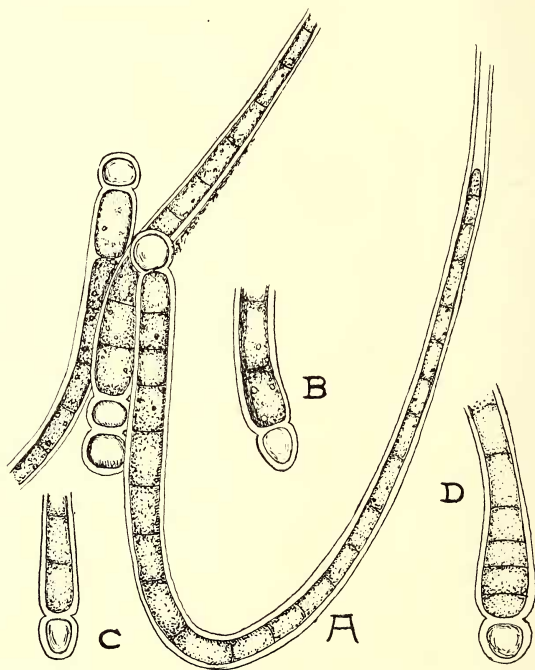


FIG. 28.—*Calothrix gracilis*, F. E. Fritsch, forma *flexuosa*, n. f. A, group of filaments, the left-hand one with a young spore. B, base of a filament with a conical heterocyst and a developing spore. C and D, bases of other filaments. All figures $\times 1000$.

other essential respects with that from the Antarctic, and it is probable that it belongs to the same species. The heterocysts exhibit the same diversity of form as was commented upon in the description of the species. Ripe spores were not observed, but the young stages seem similar to those of the type (Fig. 28, A and B).

There are not many epiphytic species of *Calothrix* possessing the small dimensions of *C. gracilis*, and these are all distinguished by the termination of the trichome in a hair. *C. epiphytica*, W. & G. S. West, also differs in the thicker sheath, whilst *C. scytonemicola*, Tilden, is stated to have indistinct sheaths and usually two basal heterocysts.

(NOTE.—Indeterminable material of this genus was also present in samples 81, 85 (*C. adscendens* (Naeg.), Born. et Flah.?), 329, 335, 345.)

IV. FLORIDEAE.

(1) HELMINTHOCLADIACEAE.

GENUS CHANTRANSIA FRIES.

1. *Chantransia chalybea*, Fries; Kuetzing, Spec. Alg., 1849, p. 429; Tab. Phycol., V, t. 41.

Sample 33 (not uncommon).

It has been established that this is actually a stage in the development of *Batrachospermum*, but in the somewhat unusual habitat development to the adult form is not likely.

V. FLAGELLATA.

EUGLENINAE.

(1) EUGLENACEAE.

GENUS EUGLENA EHRENB.

1. *Euglena spirogyra*, Ehrenb.; Lemmermann, in Pascher, Suesswasserfl. Deutschlands, etc., Heft 2, 1913, p. 131, fig. 208. (Fig. 29, A.)

Sample 19 (common), 29 (very rare).

The majority of the individuals possessed the straight body and straight posterior spine shown in Fig. 29, A, but occasionally the body had a slight spiral twist or the spine was bent to one side. The spirally arranged rows of granules on the periplast were very obvious, but appeared all to be of the same size, whereas the type is described as usually having two rows of smaller granules between each pair of larger ones. These granules are so numerous that they give the outline of the *Euglena*, as seen in optical section, a faintly crenate appearance. The angle made by the rows of granules with the main axis of the body varies somewhat, the rows

sometimes running almost longitudinally. The two paramylon bodies were always very conspicuous, the nucleus either lying between (Fig. 29, *A*) or behind them. The dimensions were: long. sine spin., 84–87 μ ; lat., 10–14 μ .

2. *Euglena viridis*, Ehrenb.; Lemmermann, *loc. cit.*, p. 127, fig. 189.

Sample 161 (rare).

Long., 54 μ ; lat., 12–14 μ .

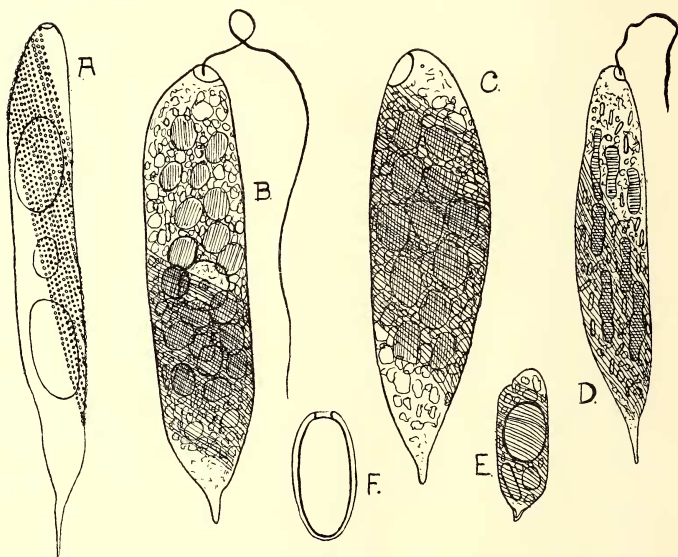


FIG. 29.—*A*, *Euglena spirogyra*, Ehrenb. (of the cell-contents only the nucleus and the two paramylon-bodies are shown). *B* and *C*, *E. proxima*, Dangeard (?). *D*, *E. terricola* (Dang.), Lemmerm. (?). *E*, *Phacus oscillans*, Klebs. *F*, *Trachelomonas cylindrica*, Ehrenb. In *A*–*D* the striation of the periplast is in all cases shown only on part of the individual. All figures $\times 930$.

3. *Euglena proxima*, Dangeard; Lemmermann, *loc. cit.*, p. 129, fig. 193. (Fig. 29, *B* and *C*.)

Sample 161 (common).

Although the material was fairly well preserved, the cell-contents were not sufficiently clear to make certain of this determination. The specimens, however, agree rather well with the diagnosis of the species given by Lemmermann. In many cases the long flagellum was recognisable. As

regards the cell-contents, whilst the presence of discoid chloroplasts is undoubted, they were not nearly as numerous as shown by Lemmermann. Definite ring-shaped paramylon-grains were also not recognised, but a large central nucleus was visible in several specimens, one of which is shown in Fig. 29, *B*. The shape exhibited by this individual was not uncommon, but the type represented in Fig. 29, *C*, which comes nearer to Lemmermann's figure and description, was also frequently seen. The delicate spiral striation of the periplast was very prominent. The dimensions were: long., 70–81 μ ; lat., 18–20 μ .

4. ? *Euglena terricola* (Dang.), Lemmermann, *loc. cit.*, p. 125, fig. 187. (Fig. 29, *D*.)

Sample 161 (rather rare).

Side by side with *E. viridis* and the form called *E. proxima* above there occurred another very slender species, the individuals of which were often roughly cylindrical, though sometimes of the form shown in Fig. 29, *D*. In a very few cases a small number of band-shaped chloroplasts were recognisable within the cell-contents and one of these specimens possessed a short flagellum (Fig. 29, *D*). These features and the presence of small rod-shaped paramylon-bodies are the grounds for referring these specimens to the above species, in the hope that a local observer may be able to verify the determination on living material. The spiral marking of the periplast was very faint and delicate. The dimensions were: long., 54–60 μ ; lat., 10–12 μ .

(NOTE.—Indeterminable material of this genus was also present in samples 67, 99, 340, and 346.)

GENUS PHACUS DUJARDIN.

1. *Phacus pleuronectes* (O. F. M.), Duj.; Lemmermann, *loc. cit.*, p. 138, fig. 236.

Sample 338 (rare).

Previously recorded from Cape Town (Fritsch).

2. *Phacus oscillans*, Klebs; Lemmermann, *loc. cit.*, p. 141, fig. 225. (Fig. 29, *E*.)

Sample 338 (rare).

Long., 26 μ ; lat., 10 μ .

Relatively few specimens of this form have been seen but they all exhibited the above dimensions. They also agree with Klebs' form in shape, the possession of a single large paramylon-grain, and the spiral striation of the periplast.

GENUS TRACHELOMONAS EHRENBERG.

1. *Trachelomonas volvocina*, Ehrenb.; Lemmermann, *loc. cit.*, p. 145, fig. 246.

Sample 22, 30 (common), 69 (very rare), 71 (very rare), 312, and 314.

Previously recorded from Cape Town (Fritsch).

2. *Trachelomonas oblonga*, Lemmermann, *loc. cit.*, p. 147, fig. 278.

Samples 19 and 29.

Long., 13 μ ; lat., 11 μ .

Previously recorded from Cape Town (Fritsch).

3. *Trachelomonas cylindrica*, Ehrenb. (*T. euchlora* (Ehrenb.), Lemm., var. *cylindrica* (Ehrenb.), Lemmermann, *loc. cit.*, p. 147). (Fig. 29, *F*.)

Samples 19, 20, 21, 22, 30 (rather rare).

Long., 18–20 μ ; lat., 10–11 μ ; lat. oris, 3–4 μ .

The elongated tests were somewhat truncated at the front end and slightly attenuated towards the back end, with an often wide aperture which projected at the most only to a very slight extent (Fig. 29, *F*). The membrane was commonly rather thinner at the back end than elsewhere. The sides were not exactly parallel, and hence the reference to *T. cylindrica* must be regarded as somewhat uncertain, although the form seems to come nearest to this species. *T. cylindrica* does not seem to belong to *T. euchlora*, in which the collar is apparently always oblique.

4. *Trachelomonas hispida* (Perty), Stein; Lemmermann, *loc. cit.*, p. 149, fig. 272.

Samples 19, 20, 29 (common), 30 (common), 158.

Var. *punctata*, Lemmermann, *loc. cit.*, p. 150.

Samples 19, 20, and 21 (in all three cases rather common), 22.

Both the type and var. *hispida* have been previously recorded from the Cape (Fritsch) and the type from Madagascar (Fritsch).

VI. PERIDINEAE (DINOFLAGELLATA).

Species of *Peridinium* were encountered in samples 311 and 312, but were not present in sufficient numbers for adequate determination.